HAND BOOK of HOLLOW BUILDING TILE CONSTRUCTION

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PUBLICATION No. 4
SERIAL No. 33
MAY, 1922

THE HOLLOW BUILDING TILE ASSOCIATION
CONWAY BUILDING, CHICAGO

ASSOCIATION ACTIVITIES

The Hollow Building Tile Association presents to the building profession this handbook which represents the best methods and most recent development of modern engineering practice in connection with Hollow Building Tile construction and fireproofing. The Association at all times welcomes suggestions for the improvement of these products or methods of use so as to better serve the interest of the building public. It is hoped that architects and engineers will avail themselves of the assistance and service that the Association is in a position to render.

Requests for information regarding the industry or its products will receive careful attention.

We also wish to announce the following program in order to outline more clearly to the building profession the services that the Association may be in a position to render.

Services:

(A) Research work to determine the best and most economical methods of using Hollow Tile and compilation of the results of such research and tests into practical specifications, tables and details for the use of architects and builders.

(B) Development of Hollow Building Tile construction as the most economical and satisfactory form of low cost, permanent fire-resisting masonry, adaptable to a very wide range of usage.

(C) Compiling information for the building profession, as well as the general public, as to the best methods of using and erecting the products of this industry and applying or adapting Hollow Tile units to the various requirements and conditions of structure and purpose.

(D) Research work to develop and improve methods of manufacture and to insure uniform products for all purposes.

(E) Research work to develop Hollow Building Tile for every suitable purpose and to determine the best types and properties of Hollow Tile for all classes of construction and the development of these products to perform the functions required in the most efficient manner.

(F) Standardizing the industry's products and the publication of standard specifications for all types and grades of Hollow Building Tile.

(G) Publication of handbooks and a complete line of literature on Hollow Building Tile construction, also technical papers and circulars giving results of research work and other data useful to the profession and the public interested in building.

(H) Co-operation with the work of allied industries and agencies in the promotion of better, safer and more sanitary fire-safe buildings, and the co-ordination of this Association's efforts with the work of all recognized national and civic societies, associations, or commissions for the improvement of housing and social conditions and the curtailment of national or civic waste.

Products of the Industry:

Hollow Building Tile for exterior walls.
- Load-bearing Tile.
- Back-up Tile, for walls faced with brick, cut stone or architectural terra-cotta.
- Smooth and texture faced wall tile.

Hollow Tile for interior partition and division walls:
- Load-bearing Tile.
- Partition:
  - "A" Fire wall enclosure.
  - "B" Sub-dividing partitions.
- Wall furring tile.

Hollow Tile for floor construction and fireproofing:
- Standard column covering tile.
- Standard beam and girder covering tile.
- Flat arch floor construction tile.
- Long span floor construction tile used with reinforced concrete.
- Segmental arch floor construction tile.
- Roof and ceiling construction tile.

Hollow Tile for special purposes:
- Hollow brick size tile.
- Hollow tile silo blocks.

Certain manufacturers also produce special Hollow Tile for corn cribs, grain bins and dry kilns; for supporting column construction; and for chimneys and other circular masonry structures.

DEFINITION OF TERMS USED IN THE INDUSTRY

The terms "shale" and "fire clay" are frequently loosely and improperly used by the laymen and those connected with the building profession. This results in misunderstandings, and for the benefit of those who are not familiar with these terms and their application to the Hollow Building Tile industry, the following explanatory definitions are given:

Hollow Building Tile, including load bearing tile, hollow tile, fireproofing, partition and furring or backing-up tile may all be made of "shale," "fire clay" or "surface clay," or a mixture of these raw earths, any or all of which, when of a composition that permits their manufacture and burning into hollow tile that will pass the crushing and absorption requirements set forth in the test requirements for standard tile, are entirely satisfactory for this purpose.

The standard specifications for crushing and absorption of the Hollow Building Tile Association eliminate all unsatisfactory tile and assure the purchaser of a sound, permanent and uniform product, and except where the very dense or vitrified tile is required for foundations or similar requirements, no distinction or reference is made to the type or kind of clay used, the main groups of which may be defined as follows:

Shale is a stratified, fine grained clay, deposited in the still water, prior to the present geological era, possesses a well defined parallel cleavage and has become more or less indurated by pressure. It is usually red burning.

Fire Clay is a stratified clay, laid down prior to the present geological era, frequently, but not always, associated with the coal measures, varying from a comparatively soft to an indurated rock-like structure which shows conchoidal fracture. It usually fires to a buff color and, owing to its lower content of fluxes, is more resistant to higher temperatures than the red burning clays.

Surface Clay is an unstratified, unconsolidated plastic clay, carrying more or less sand, laid down on the flood plains of rivers or in lakes, or deposited by the glacial ice sheet and hence geologically of recent origin. This type of clay is usually red burning except when naturally blended with finely divided carbonate of lime, when it assumes a cream or buff color upon firing.

Salt Glazed Tile is a product of shale or fire clay that is glazed in burning by the introduction of common salt into the kiln, while hot, which vaporizes and enters into a chemical combination with the silica of the clay, thus forming a glassy coating or glaze on the exposed inner and outer surface of the tile. A salt glazed tile is resistant to the action of most acids and other chemical agencies and vapors, and has no surface absorption where the glaze is intact.

Vitrified Tile is a product which has been fired to a temperature that has resulted in incipient softening and contraction of the clay, so that the open pore space has been partly or almost entirely eliminated and the structure has become more or less impervious to the penetration of water. A vitrified tile is nearly impervious and generally has a very low average absorption value.

GENERAL CHARACTERISTICS OF HOLLOW TILE

Hollow Building Tile is an incombustible product of burned clay or shale of high structural value, which may be divided into five grades of ware, each of which is more or less particularly adapted to certain requirements, and all of which may be used for certain other purposes.

The five grades are as follows:

(1) *Very Hard Burned or Vitreous:* All Hollow Tile which have less than 8 per cent absorption may be placed under this heading which calls for a very hard dense product, specially suitable for the construction of foundations or other work in contact with the earth or for exterior walls without stucco or other covering, where the exposure to weather and resistance to moisture are of prime consideration.

(2) *Standard Hard Burned:* This calls for a Hollow Tile having not over 12 per cent absorption which is the standard specification for loadbearing tile for exterior walls and other similar work where the walls are to be stuccoed or veneered with brick, stone or other covering. The Hollow Tile in this grade may be either dense or semi-porous ware, as if of a semi-porous ware, it must be burned to a degree of hardness that seals up the minute cells contained within the walls and makes their presence negligible in-so-far as the strength and suitability of the tile to physical requirements is concerned.

(3) *Ordinary or Medium Burned:* Under this classification falls the major portion of all Hollow Tile manufactured for fireproofing and interior construction, and it is best described as a tile having an absorption value greater than 12 per cent, but otherwise reasonably hard burned, dense or semi-porous in structure and having a perceptible ring when struck. This ware is often referred to as semi-porous, but as porosity and absorption are two different factors, the term semi-porous should not be applied to designate a lighter burned ware of dense structure. Generally this is the grade of ware preferred by mason contractors and by plasterers for all interior work, because of the suction which helps make the mortar or plastering adhere and "hang" and, consequently, saving in labor for erection. This grade of ware for this very reason is not generally suitable for exterior wall work, unless waterproofed stucco is used and it further often does not develop the crushing strength that is required of Hollow Tile for load bearing walls.

(4) *Soft Tile:* Two kinds of tile fall under this heading: first, the ordinary underburned dense tile, which is the first cousin to salmon brick and about which no more need be said, although it has its special sphere of usefulness and is still used to a great extent for interior work in some sections of the country. Second, full porous tile which is made by the addition of sawdust or other combustible matter to the raw clay, producing a tile that can be nailed into. Porous tile altho generally made with quite thick shells, is somewhat lighter in weight than the standard or ordinary ware, and has a comparatively low crushing strength, but is specially adapted for book tile, roof and ceiling blocks, nailing blocks and other special purposes for which this grade of ware is used.

(5) *Salt-Glazed Tile:* This classification or grade refers to a dense tile of fire clay or shale that is glazed in burning like a sewer pipe or conduit and it is therefore specially adaptable to resist the action of moisture and frost and for that reason is extensively used for foundation purposes. Most of the original building tile made by the sewer pipe manufacturers before Hollow Building Tile construction was developed as an industry, were of this grade of ware and these salt-glazed building tile continue to be extensively used for wall construction in certain sections of the country.

Frequently the term vitrified is used to apply to salt-glazed ware, although a clay can hardly be glazed without being vitrified; therefore to avoid confusion, it is best to use the term vitrified as applying to a very hard burned unglazed tile.

Strength of Structural Tile:

Hollow Building Tile in all but the softer grades of ware develops a crushing strength that enables it to be used for the construction

of load-bearing walls, and when built in the wall it will support a load approximately from five to twenty times the weight of the wall itself, with an ample factor of safety for all walls of normal heights. The limiting factor in the support of load or resistance to stress in all of the hard burned grades of tile is usually the strength of the mortar joints, as the tile develops a crushing strength greatly in excess of the strength of average good Portland cement mortar. For this reason, in load-bearing walls only a fairly rich Portland cement mortar should be used, and even for interior fireproofing purposes a cement mortar should be used on account of its greater fire-resistive qualities.

Fire Resistance:

Hollow Tile, being the product of the hottest of fires, has a very high resistance to the action of fire and has withstood the extreme test of many conflagrations. When used properly, Hollow Tile fulfills the most exacting requirements of fire protection. An excellent bond is obtained between cement mortar or concrete applied to or deposited on Hollow Tile, and therefore Hollow Tile may be combined with these very useful structural elements in many various ways. There is hardly a concrete building structure in which Hollow Tile cannot be used to advantage, and in nearly all Hollow Tile buildings concrete is used for special purposes.

Weight of Hollow Tile Walls:

The density of all the hard grades of Hollow Tile is such that the absorption factor is very low and it therefore effectively resists the action of moisture and frost, both above and below grade, and it is not affected by acids.

A cubic foot of Hollow Tile weighs from 40 to 50 lbs., while the same quantity of cinder concrete suitable for structural purposes weighs about 100 lbs., and stone gravel concrete from 140 to 150 lbs., and a cubic foot of brick work will average not less than 120 lbs. This lightness, combined with strength and other physical properties, makes Hollow Tile the ideal material for fireproof building construction, whether used alone or in combination with reinforced concrete.

Ease of Inspection:

Hollow Tile is not deceptive, it is not the result of a mixture or compounding of different elements; burned clay and only burned clay constitutes its structure, and when the burning is right, satisfactory tile is assured. If not properly burned, this fact is evident from a most casual inspection. This ease of inspection and assurance as to quality is a valuable factor to the architect or engineer, as all questions regarding workmanship in manufacture are eliminated.

Varied Use:

Hollow Tile construction was originally developed to make possible the erection of all skeleton frame structures, in connection with which it effectively protects the structural steel frame from corrosion and fire, at the same time forming the structural element for floors and partitions which encase the frame and divide the space enclosed by same into floors and rooms, etc.

At the present time one of the greatest developments is for the construction of low cost walls for residence, apartment houses, farm buildings, school houses, factories, garages, etc., in which field it most effectively fulfills the demand for easily erected, enduring masonry construction, at minimum initial and maintenance cost. The insulation value of the hollow, moisture-proof, vermin-proof, sound-proof walls, that are so easily erected from the units provided, make it particularly well suited to these types of structure.

Manufacturing Facilities:

Numerous plants for the manufacture of Hollow Building Tile are distributed throughout the Eastern, Middle-Western, Southern, South Western and Pacific Coast sections of the United States, many adjacent to the great cities and all within easy shipping distance of all points, making it possible to obtain this product without excessive freight charges, except in the most remote sections of the country.

ADVANTAGE OF HOLLOW TILE WALLS

Strength:

The strength of any wall is chiefly dependent upon two factors: first, the material or units of which it is built, and second, the method of joining or building the material or unit in place.

In Hollow Tile construction the first item is the tile, and in these units we have a material which has an ample surplus of strength, for all ordinary requirements, greater than any cementing bond of mortar that may be used in its erection. The strength of any wall built of this material is therefore, as with most forms of wall construction, dependent on the second factor or cementing medium.

With all forms of Hollow Building Tile construction only a cement mortar should be used, and the amount of mortar required is comparatively so small that there is little reason for using anything other than a good rich mixture. A wall of hollow tile properly laid in a good cement and lime mortar will develop about 60 to 75% of the strength of the tile and this assures a very strong wall.

There is a peculiar analogy between the methods of laying up Hollow Tile and the comparative strength of these methods which may be explained as follows:

The difference in volume and bed of the mortar joint between side construction and end construction offsets the difference in ultimate crushing strength of the tile, when built up in the wall, between side construction and end construction.

Therefore, regardless of the method used, the strength of the finished wall is about the same. So it is a matter of choice based on personal preference and other considerations as to which form of construction should be used.

Depreciation:

Closely connected with the question of strength is the question of depreciation of the material itself. The cementing medium must also be considered.

In Hollow Tile construction there is absolutely no depreciation of the material itself. Hard burned clay has stood through all the ages and will continue to do so as long as man exists on earth. The cementing medium is almost equally as permanent. This material was used by the Romans and is responsible for the wonderful permanence of their great masonry structures. There is a further feature to consider:

In most forms of Hollow Tile wall construction the cement joints between the tile are covered and protected from the ravages of the elements by the stucco finish or veneer of brick or stone.

Insulating Value:

Heat or cold may penetrate the walls of a building in two ways: first by conduction through the solid material of which the wall is built, as all materials are more or less conductors of heat and cold, and second, by leakage, either through the wall construction or around window and door frames.

There can be no appreciable leakage through any dense masonry material, and the hard burned clay of which Hollow Tile is made is an effective bar to any such leakage. Furthermore, there can be no leakage around door and window frames that are properly set and caulked tight in Hollow Tile walls. Conduction is the only way by which heat or cold may be transferred through a wall of Hollow Tile. Air, particularly dead air, is the poorest conductor of heat, and for this reason it is utilized for the purpose of insulation in Hollow Tile construction. Air cells are built into the wall in such a manner that any conduction of cold through the solid material is absorbed and neutralized within the wall itself. In winter the interior of the wall becomes warmed by the interior temperature of the building and when thus warmed will set up air currents within the tile cells that will oppose and neutralize the transmission of heat induced by the outside cold.

This insulating effect is less with the thinner sizes of tile that have only a single air cell through the thickness of the wall and is multiplied by the number of cells that are added by any greater thickness of wall.

The furring of any wall adds to its insulating value as it adds another air cell and further removes the interior plastering or other finish

from direct contact with the wall proper. Thus for the small residence where only an 8″ thickness of wall is generally used, it is advisable to have the added insulation advantage and the resultant saving in fuel. It is not necessary to furr a Hollow Tile wall in order to avoid cold or dampness. Probably 50% of the Hollow Tile walls that are built have the plastering applied direct to the tile without furring. An 8″ Hollow Tile wall unfurred is better than most frame walls or other types of wall, but furring is nevertheless an advantage that well repays the slight additional cost in residence buildings. As the walls increase in thickness furring becomes of less and less value and for all ordinary temperature extremes there is a question if any advantage is gained when the wall is 16″ or more in thickness.

A properly constructed tile wall has never been known to fail as an effective resistant to the transmission of heat.

Dryness:

There are two ways by which the inside surface of any wall may become damp or wet; first, by absorption of moisture from the outside, either from rain, snow and damp outside air or by capillary attraction from the moist ground in contact with the lower portion of wall, and second, by the condensation of moisture from the interior atmosphere, generally referred to as "sweating."

Condensation or sweating is a condition that is common to all walls under certain conditions and may occur with any form of wall construction however perfect the insulation that particular construction may afford. Where the interior air becomes over-saturated or laden with steam from cooking and laundry work, the only cure is ventilation, or the circulation of dry air. Condensation will naturally occur to a much greater extent with walls that have a low insulation value, and the wall of Hollow Tile is therefore less liable to this condition than most other forms of construction.

In residence buildings all troubles from condensation generally originate with the cooking in the kitchen or from laundry work and can usually be entirely eliminated if a hood is placed over the range or cook stove, connected by a register to the flue or vent.

The first cause of damp walls, that of absorption, does not require consideration in-so-far as the Hollow Tile is concerned, as this product is burned to a density that renders the absorption too low to cause trouble even under the most severe weather conditions. Hollow Tile is essentially a dry wall and therefore promotes health. Damp walls are very unsanitary, and apart from their general bad effects on the health of inmates, germs and bacteria will prosper and multiply, particularly in warm weather, under such conditions. In order that no portion of damp-resisting properties of the Hollow Tile wall may be lost, the cement mortar that is used in laying the tile should be a dense mixture, and for that, as well as other reasons, it is customary to add about 15% of hydrated lime to the cement. Cement mortar is always more absorbent than the Hollow Tile and this addition of lime should not be omitted, except where a waterproofing compound is used in the mortar.

Apart from foundation and cellar walls or other walls in contact with the earth, there is little danger of any moisture permeating a Hollow Tile wall, and in order that the tile for foundation may be safeguarded against a defective mortar joint that would permit ground water to enter the cells of the tile, it is customary to cover the exterior face with a coat of dense cement mortar or brush the face of the tile with an asphalt or tar damp-proofing compound.

Hollow Building Tile properly laid will make a bone dry cellar and there is no better material for residence foundations.

Fire-Resistive Walls:

To be fire-resistive, a wall must first be built of incombustible material; second, it must withstand heat without cracking, disintregating, or losing its strength. In the manufacture of Hollow Tile, man is simply duplicating the earth's process of rock making on a small basis. A wall built of hard burned clay cannot be burned or destroyed by fire. Furthermore, being a non-conductive wall, it will protect

inflammable material on the opposite side from ignition or damage. It is a dependable fire wall material. Where the Hollow Tile is confined and anchored to some structural member there may be a good reason for using a porous tile that will internally absorb any expansion from heat, but for wall purposes there is greater opportunity for expansion, and the stronger dense tile is the recognized standard wall material.

Permanence:

There is no maintenance expense connected with the Hollow Tile wall. It is built to stay for all time and when the last tile has been laid completing the wall, there is no expense whatever in the way of maintenance and repairs.

COMPARISON OF TILE SIZES WITH BRICK

Allowing for the joints in brick work, the several sizes of standard hollow tile are equivalent to the following number of brick, based on the standard size common brick as adopted in February, 1920, which is 8″ x 2¼″ x 3¾″.

⅜″ thick joints are allowed for in connection with brick.

4 x 12 x 12 tile equals	7 bricks
8 x 12 x 12 tile or wall equals	14 bricks
12 x 12 x 12 tile or wall equals	21 bricks
4 x 5 x 12 tile equals	3 bricks
8 x 5 x 12 tile equals	6 bricks

STANDARD SHAPES OF TILE FOR END CONSTRUCTION

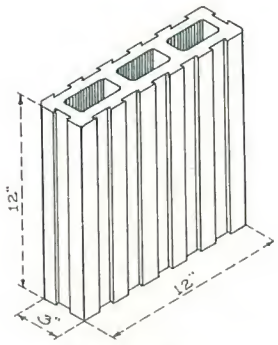


Fig. 1019-A
Weight, 18 lbs.

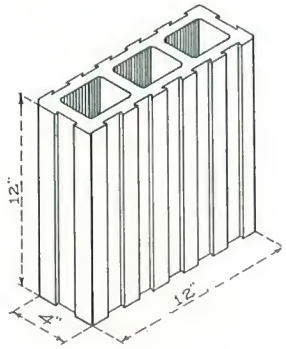


Fig. 1019-B
Weight, 20 lbs.

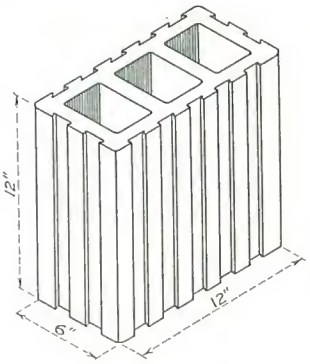


Fig. 884-C
Weight, 30 lbs.

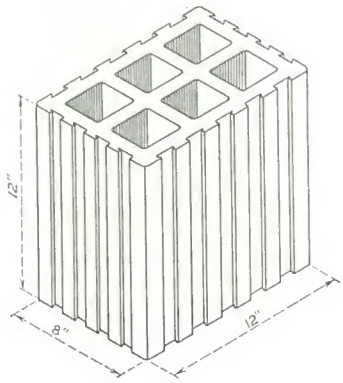


Fig. 880
Weight, 36 lbs.

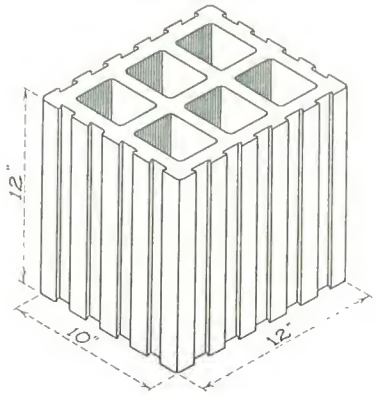


Fig. 1023
Weight, 42 lbs.

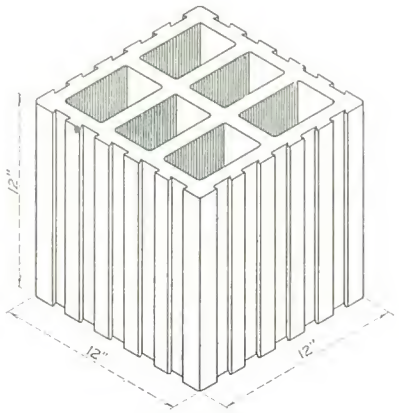


Fig. 1021
Weight, 48 lbs.

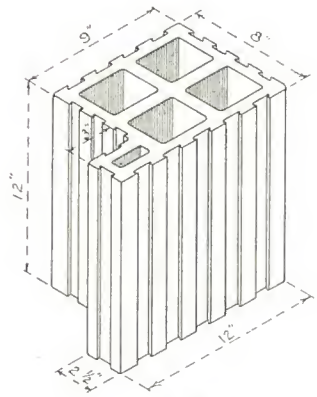


Fig. 938
Jamb Tile.

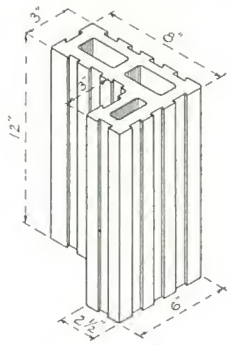


Fig. 939
Half-Jamb Tile.

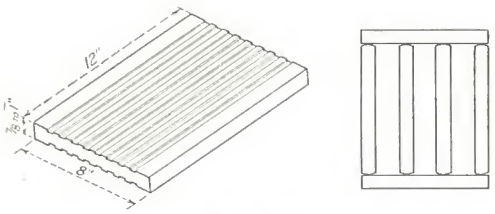


Fig. 928.

1″ Slabs. Showing form in which they are usually made. A tap on the corner separates the tile into slabs. Made in required wall widths up to 12″.

The weights of the tile given above are approximate, as differences in the density of clays and shales make some difference in the actual weights. These figures allow an ample factor of safety for use in figuring loads and stresses.

STANDARD SHAPES OF TILE FOR SIDE CONSTRUCTION

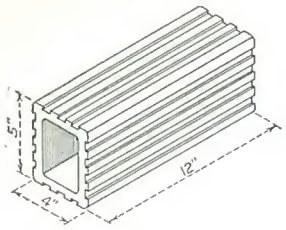


Fig. 877-A
Weight, 9 lbs.

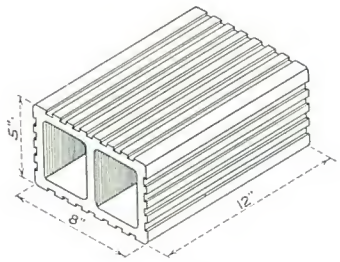


Fig. 877
Weight, 15 lbs.

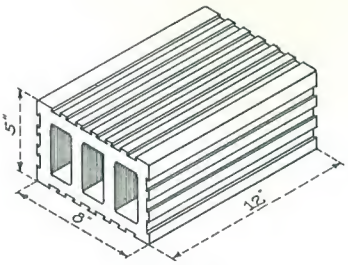


Fig. 1018
Weight, 17 lbs.

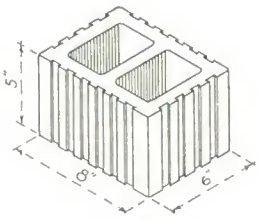


Fig. 948-A
Half-Closure Tile.

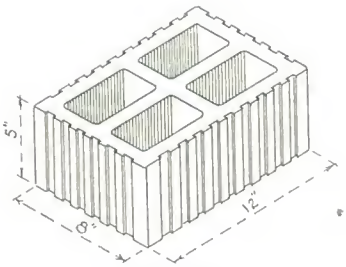


Fig. 948
Closure Tile.

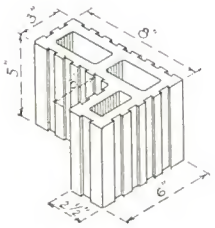


Fig. 949-A
Half-Jamb Tile.

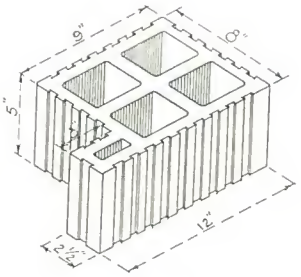


Fig. 949
Jamb Tile.

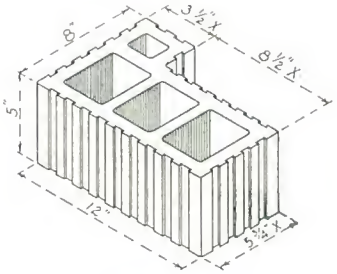


Fig. 950
Special Corner Tile.

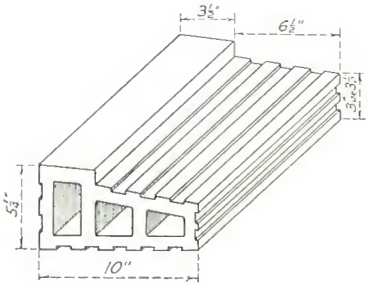


Fig. 906
Sill Tile for both End and Side Construction.

The weights of the tile given above are approximate, as differences in the density of clays and shales make some difference in the actual weights. These figures allow an ample factor of safety for use in figuring loads and stresses.

STANDARD SHAPES OF PARTITION OR FLOOR TILE

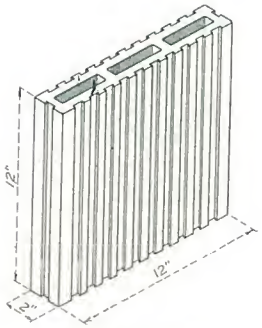


Fig. 1022
Weight, 14 lbs.

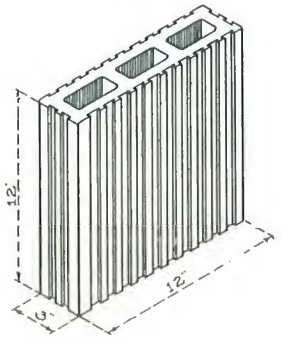


Fig. 1019-C
Weight, 16 lbs.

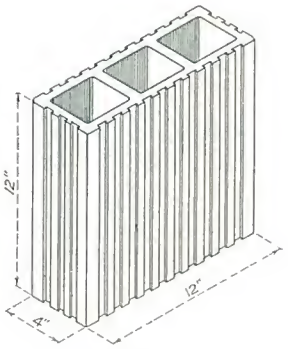


Fig. 1022-A
Weight, 18 lbs.

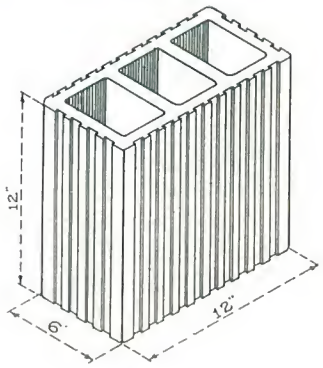


Fig. 1019-D
Weight, 22 lbs.

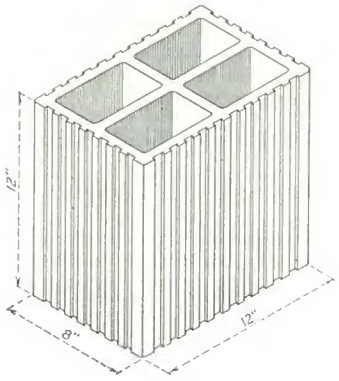


Fig. 1020
Weight, 30 lbs.

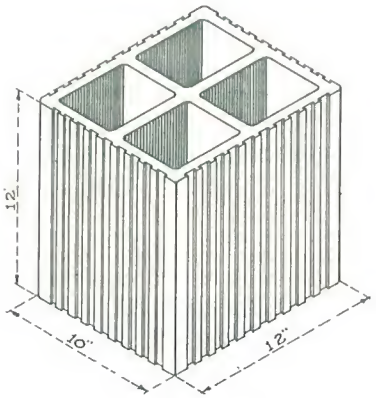


Fig. 1019-E
Weight, 36 lbs.

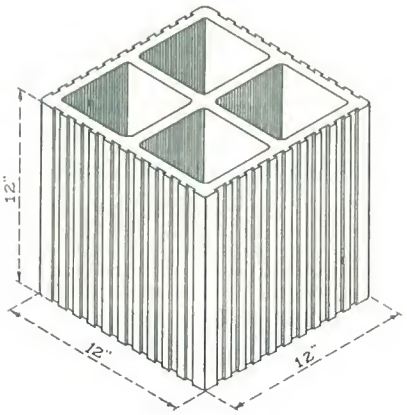


Fig. 1019-F
Weight, 40 lbs.

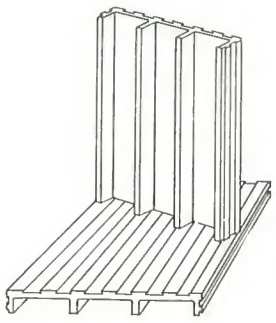
The following special sizes can be furnished by some manufacturers: 5x12x12, 3 cell, weight 20 lbs.; 7x12x12, 3 cell, weight 25 lbs.; 9x12x12, 4 cell, weight 33 lbs.

SPLIT FURRING TILE

Before Separation

1½x12x12
Weight, 8 lbs.

2x12x12
Weight, 9 lbs.



After Separation

The weights of the tile given above are approximate, as differences in the density of clays and shales make some difference in the actual weights. These figures allow an ample factor of safety for use in figuring loads and stresses.

HOLLOW BUILDING BLOCKS

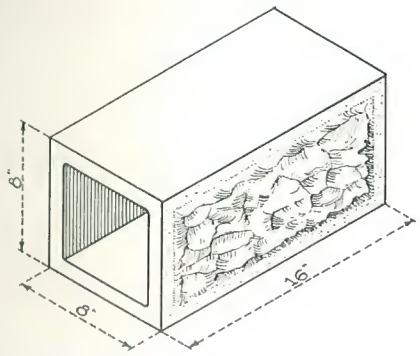


Fig. 1017-A

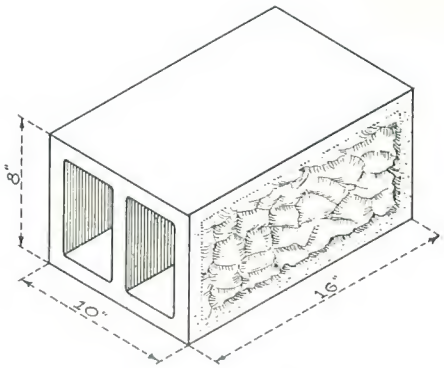


Fig. 1017-B

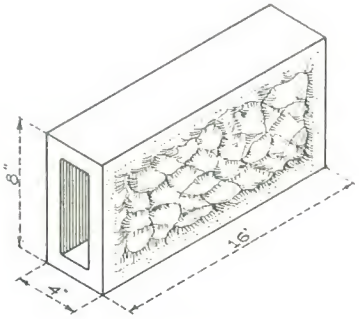


Fig. 1017

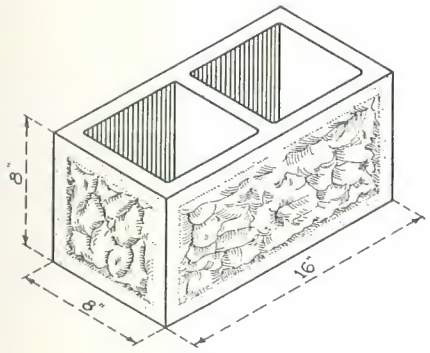


Fig. 1087
Corner Block

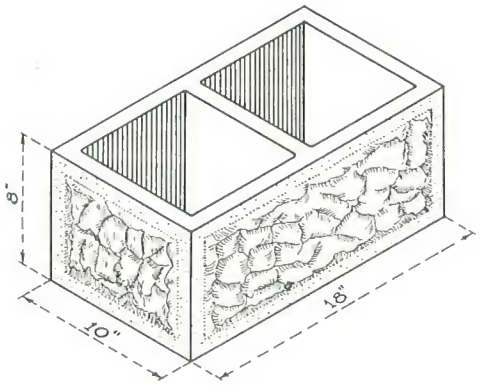


Fig. 1087-A
Corner Block

HOLLOW TILE FOR LOAD-BEARING WALLS

The strength and resultant carrying capacity, the comparative lightness in weight and consequent saving in structural material and the economy and ease of erection, combined with permanence and resistance to fire and weather, have naturally fostered a very large and constantly growing use of Hollow Building Tile for load-bearing walls, in residence buildings, including flats and apartments, churches, schools and skeleton frame buildings, for both residence and commercial purposes. In the former, it may replace the more extensive forms of solid masonry, either used with stucco finish or as a backing for brick or stone work, but it is more often used in place of frame wall construction on account of its permanence, freedom from shrinkage and cracking, and other advantages.

In the skeleton structures, while sometimes finished with stucco, it is generally used as a backing for face brick or cut stone, and for this purpose it combines with other advantages that of greatly reducing the weight of wall to be carried on the skeleton frame and consequent saving in structural steel or reinforced concrete frame and the supporting foundation.

In connection with load-bearing Hollow Tile walls for small to moderate sized residences, garages, stores and similar buildings, Hollow Tile foundation walls have ample strength and are in every way satisfactory. This type of foundation wall gives a drier basement or cellar than the average solid masonry wall of similar thickness. In certain sections of the country such walls have been used under frame houses for a great many years, in fact before any houses with Hollow Tile walls above grade had been built. When foundation walls are built in an occasionally saturated soil, the exterior face should be plastered with a coat of cement mortar in order to insure the sealing up of any small openings in the mortar joints. Hard burned tile of low absorption should be used below grade. The greatest danger to a Hollow Tile foundation wall or to any solid masonry foundation wall is at the grade line, where the continual freezing and thawing is a tax on the permanence of all structural materials. In order to strengthen "the weakest link in the chain," it has been customary, with many forms of brick and other solid masonry, to build in a course of stone or other very dense material, and where a stucco finish on Hollow Tile walls is carried down to grade, such a grade course is advisable though not necessary. This grade course may be of a dense cut stone, a very rich concrete mixture, or a course of vitrified paving or other hard brick on end. Good types of grade course details are shown on page 30.

The standard shapes, sizes and weights of load-bearing wall tile, both for side and end construction, are illustrated on pages 10 and 11.

The shape shown in Fig. 950, page 11, cut in 12″ lengths, may also be used as a corner block for walls of 8″ x 12″ x 12″ end construction units, where the wall is built of smooth or glazed tile that is to be left exposed.

The shapes shown by Figs. 948, 948A, 949 and 949A are given for exterior dimensions only, as the interior arrangement of cells and cross webs may vary to suit the varied product of the different manufacturers, many of whom feature special forms of load-bearing tile, some of which are patented, and for all of which certain particular advantages are claimed. The figures which we illustrate show only the standard products that are universally manufactured. For information regarding special forms of load-bearing tile consult the individual catalogues of the different manufacturers.

End construction walls do not require closure tile at plain jambs and wall ends, as a full tile forms the full closure and a half or cut tile or corner tile is used for the half closure. Similarly, as the side construction wall does not require the horizontal closing of cells under window sills, roof plate, etc., the vertical cells in an end construction tile should be capped off under all openings, at all joist bearings, and on top of wall under roof plate, cornice or coping. Even where a terra-

cotta or stone coping is used, the top of the wall should first be capped off so as to close the cells and give a proper setting bed for coping.

For these purposes a slab or plate of tile is used which is furnished in the various widths required: 4″, 6″, 8″, 10″ and 12″ in 12″ lengths. These slabs are about 1″ in thickness and may be supplied singly, in pairs, or in nests of 4 to 8, according to the method of manufacturing same.

Fig. 906 on page 10 is only shown as an example of the sill tile for the various thicknesses of load-bearing walls, which are made by manufacturers who specialize in load-bearing wall tile. These shapes are not standard dimensions and further information should be obtained from the manufacturers' catalogues.

Special sill and window jamb shapes for metal frames and for other purposes are also manufactured to order and are carried in stock by some manufacturers.

With the range of shapes now obtainable from any manufacturer of load-bearing tile, it is practicable to build the entire walls of most residence, factory or other structures without the use of any special shapes.

In the agricultural localities hard burned ordinary 8″ x 5″ x 12″ building tile is more extensively used than any other shape, and in fact few other shapes are used. If the farmer wants to build a garage or a chicken house, he builds an 8″ or 5″ wall with the tile flatwise or on edge; if a barn, a residence or a dairy building, he lays it flat, building an 8″ wall.

Many architects could profit from the lesson of low cost permanent construction that is being shown by what the Iowa farmer is doing with Hollow Building Tile today.

When arches occur in walls, they can very easily be turned with the Hollow Tile blocks or with hollow brick. Due consideration to the proper abutment of such arches should be given. It is not advisable to build arches too close to the corners of walls or to have them supported on slender piers.

The plates showing details are drawn for walls 8″ thick above first-story joist, as this is the typical and recognized standard construction for all ordinary residence buildings. Some city building codes do not permit masonry walls of any type to be less than 12″ in thickness, but this waste of structural material, in view of modern developments, is rapidly being eliminated by the revision of these old codes.

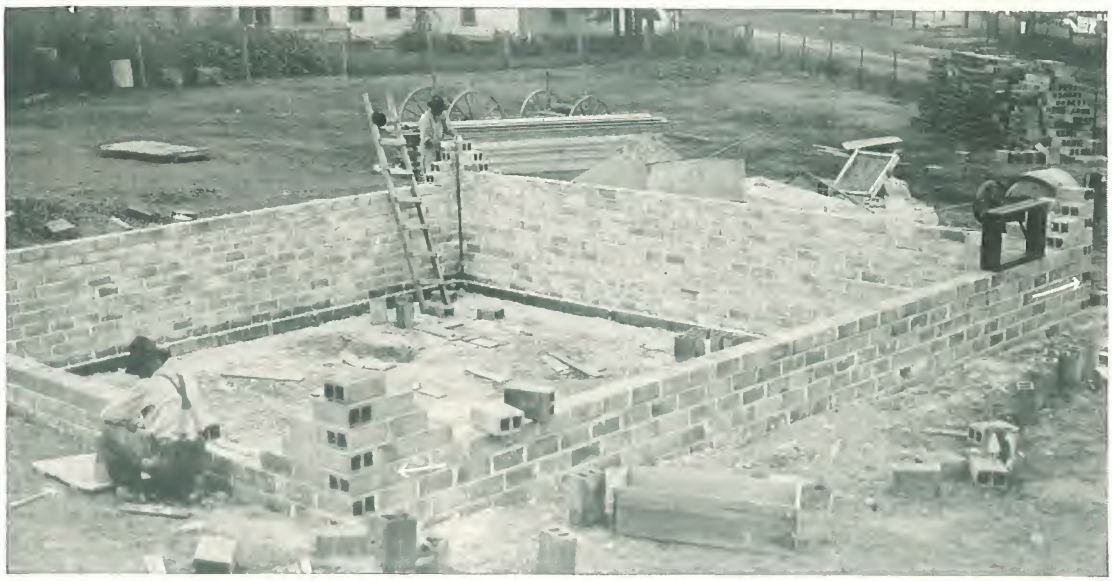
The plates show 12″ thick foundation walls, as this is also somewhat typical by reason of building code restrictions. An 8″ thick Hollow Tile foundation wall is ample for all moderate sized residence buildings, where the length is not too great between corners or cross walls, or bracing piers, such as are formed by chimney foundations, or other thickening up of wall.

Details for load-bearing tile as a backing for brick and stone ashlar are shown on page 27. Face brick and Hollow Tile have been successfully used together for a long time. The combination of Hollow Tile and sawed stone ashlar has great possibilities that have not yet been fully developed, but which are sure to be quite a factor for certain classes of buildings in the future. Many people prefer cut stone to stucco or face brick and are willing to pay the extra cost for a surface of limestone.

The regular light weight "backing-up tile" is designed for the backing up of face brick or for enclosing or curtain walls of skeleton structures. When Hollow Tile is used for primary or load-bearing walls, the load-bearing 8″ x 5″ x 12″, 4″ x 5″ x 12″ or other form of load-bearing tile should be used. A number of special forms of load-bearing tile for backing-up purposes are made by the various manufacturers, also some feature the end construction tile for this purpose and furnish specially designed bonding blocks.

In all cases, in load-bearing walls, where face brick or cut stone and Hollow Tile are used in combination, a masonry bond between the two materials should be used so that the full thickness of the two materials can be counted as the thickness for load-bearing purposes to comply with code requirements, as otherwise the carrying capacity of the facing material is seldom considered. Very few city building codes will permit the facing material to be figured as a part of wall, where only metal ties or anchors are used.

THE NECESSITY OF SEALING THE EXPOSED ENDS OF HOLLOW TILE



Where either end or side construction is employed it is absolutely necessary to completely seal any exposed cells in the tile. In end construction the walls must be capped off at each joist course, under all window and door sills and at top of wall, with 1″ tile slabs. In side construction the jambs of all openings and the exposed corners must be properly sealed.

This illustration shows the construction of corners by using the open end method of bonding, as indicated by the arrows. This method of bonding corners is entirely wrong, as it allows the free circulation of air and moisture through the walls, which cause dampness and condensation to appear inside the building. Corner tile should be used. In localities where corner tile are difficult to obtain, open ends must be thoroughly sealed to air lock the insulating air chambers.

This can be readily done by placing the tile (with the cells in a vertical position) upon a board and pouring concrete into the cells to the required depth. After the concrete has taken its initial set these blocks are ready for use in the walls.

Brick corner bonds are shown on page 20.

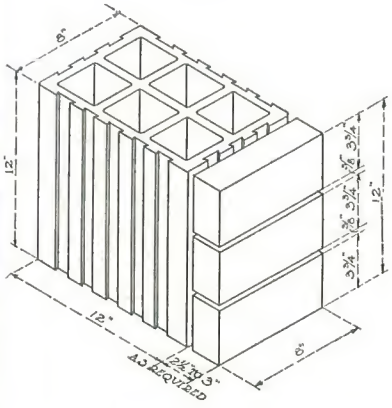


Fig. 966
Showing use of common brick with 8x12x12 tile. Brick may be used in a similar manner to close up ends of cells when this shaped tile is laid up in side construction.

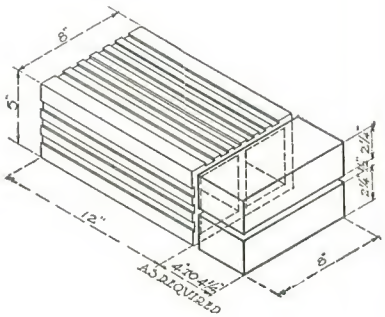


Fig. 965
Showing use of common brick for closing ends of cells in 8x5x 12 tile.

BONDING OF WALLS

The placing of openings for doors and windows in Hollow Tile walls and the details for bonding of walls at corners and around openings is naturally divided as follows:

First—Walls that are to be stuccoed or otherwise veneered and for which the breaking of joints between courses is required only for strength.

Second—Walls built entirely of Hollow Tile and for which the bond is required both for strength and appearance.

Generally a smooth or texture face tile is used for farm buildings, placing such buildings under the second classification. The ordinary rough structural tile is generally used for homes finished with stucco or brick.

There is no valid objection to the use of an ordinary scored building tile product for any rough or unfinished structure, providing the tile is of the hard burned variety having a low absorption value and preferably has little or very shallow scoring on the faces.

Any bonding that gives suitable strength to the wall will meet the requirements of the first instance, while only a bond which combines with this in an even working out of the courses between openings, conforming to and aligning with the running bond throughout the balance of the wall will generally be considered satisfactory for exposed tile walls. For this latter reason a 6″ running bond is usually preferred, having the joints between the tile in one course occur midway over a tile in the course below.

It will be noted from the accompanying details that the 6″ bond has a decided advantage, as it simplifies the working up to and bonding around openings. In any wall in which a finished jamb or reveal is required at openings, it is customary to use two shapes or sizes of tile, one the full 12″ length and the other a short or half-length to accommodate the running bond of wall courses. These are referred to as "full closures" and "half closures" where the end face gives a straight reveal, or "full jambs" and "half jambs" when the end face is rabbetted to form a recessed reveal, to provide for box window frames. Typical "jamb" and "closure" tile for an 8″ thick wall built with 8″ x 5″ x 12″ building tile are shown on page 11.

Naturally these shapes must be made to some standard length, and as the full jambs and closures are made to conform with the standard length of the regular building tile, the short jambs and closures are accordingly made to half the length less ¼″ to allow for thickness of vertical mortar joint. These sizes therefore call for a 6″ running bond.

The advantage of this bond is explained by the diagram Fig. 117, which shows the placing of an opening on walls that have the vertical joints between tile in alternate courses evenly staggered giving a 6″ running bond. It will be noted that only two shapes are required to work up to opening, the full and half-length tile, also that the sill and lintel will have an even projection and bearing each side of opening.

It is very seldom that the layout of openings and courses in any ordinary building cannot be arranged to conform to the even arrangement shown by Fig. 117, by adopting sizes for the door and window frames that will conform to multiples of full or full and half-length tile with allowance for joints as already referred to. This gives steps of 6¼″ in width of openings. Details for the various corner bonds for 4″, 5″ and 6″ walls are given on the following pages.

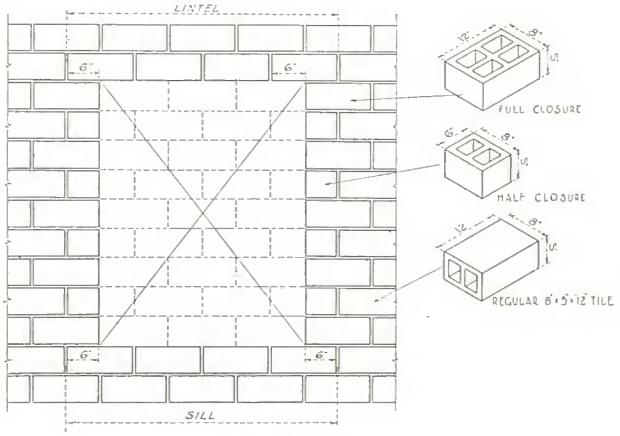


Fig. 117

Method of allowing for closures and half-closures in connection with window and door openings to secure proper bonding in the wall.

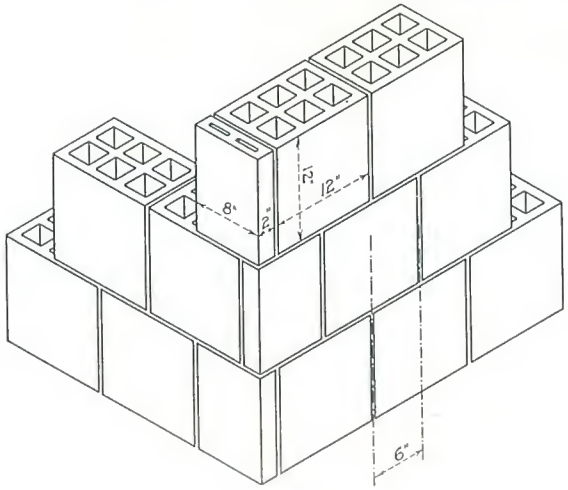


Fig. 115
End Construction 8" Wall.

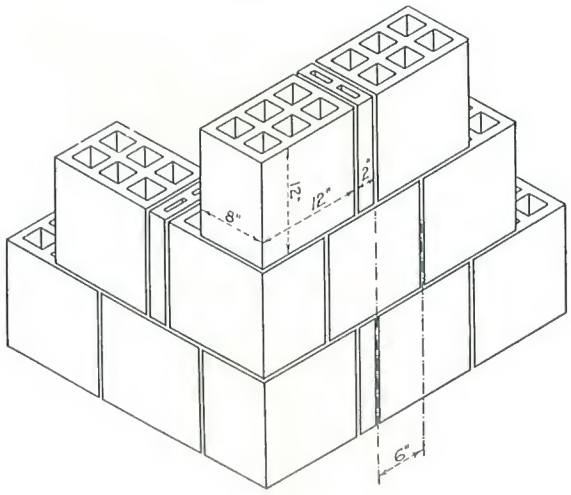


Fig 114
End Construction 8" Wall.

This makes a uniform bond for exposed walls.

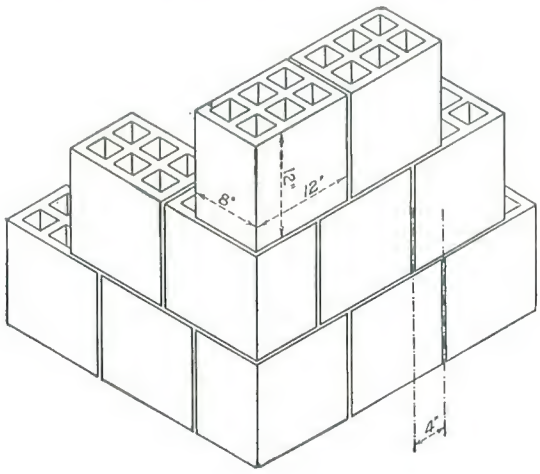


Fig. 113
End Construction 8" Wall.
The usual method of bonding corners when wall is to be stuccoed.

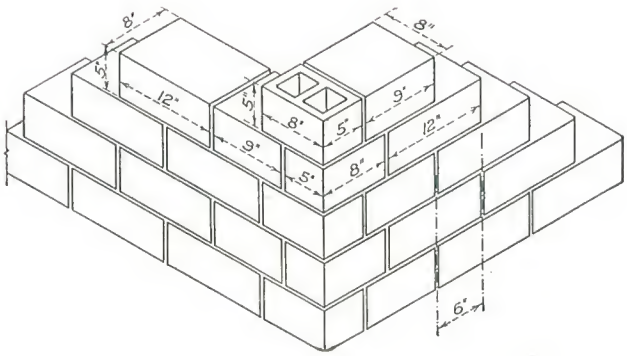


Fig. 101
Corner bonds for 8" wall, side construction.

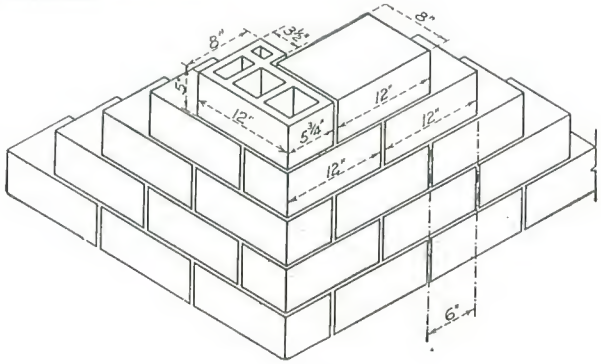


Fig. 102
Corner bonds for 8" wall, side construction using special corner tile.

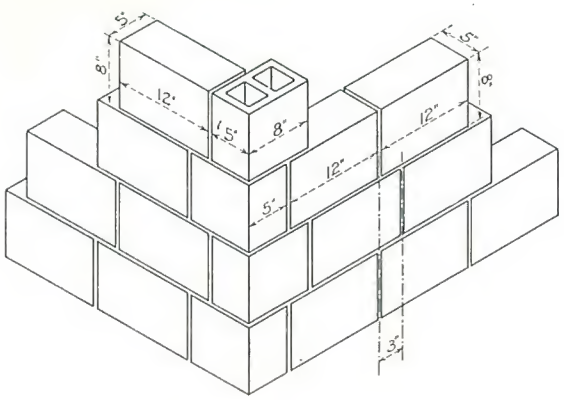


Fig. 104
Usual method of bonding corners of 5" wall for side construction where wall is to be stuccoed.

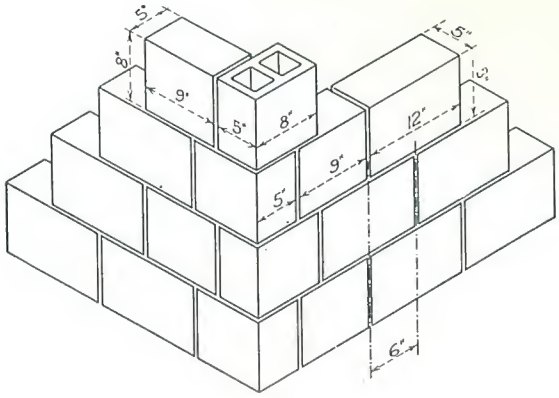


Fig. 105
Use of 9" lengths to make even break bond where wall is to be exposed.

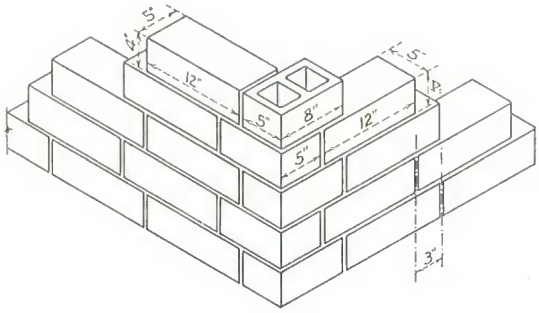


Fig. 110
Usual method of bonding corners where wall is to be stuccoed.

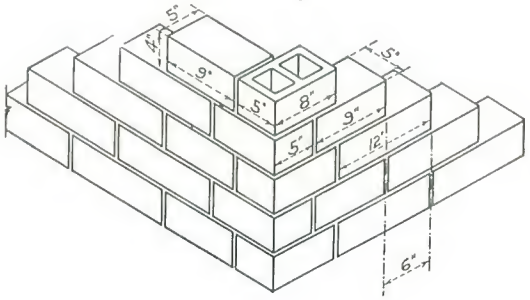


Fig. 111
Use of 9" lengths to make even break bond where wall is to be exposed.

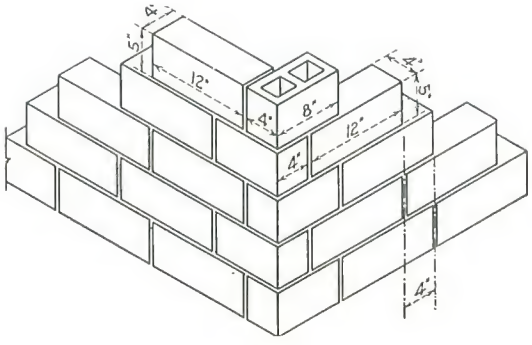


Fig. 108
Usual method of bonding 4" wall at corners where wall is to be stuccoed.

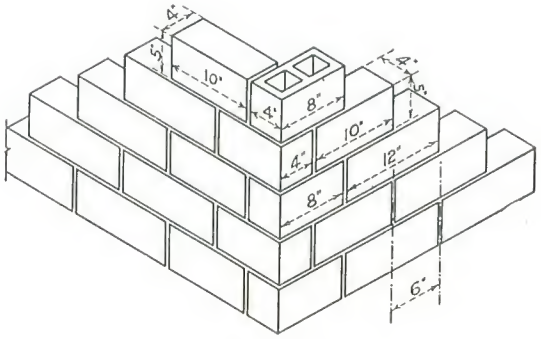


Fig. 109
Use of 10" lengths to make even break bond where wall is to be exposed.

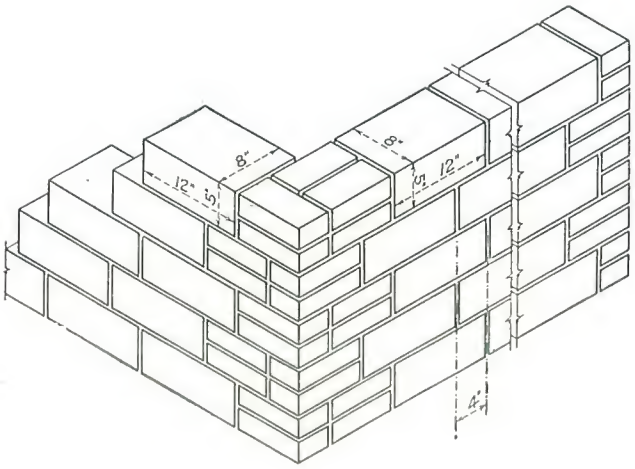


Fig. 103
Common brick used for corners and openings on side construction 8" wall.

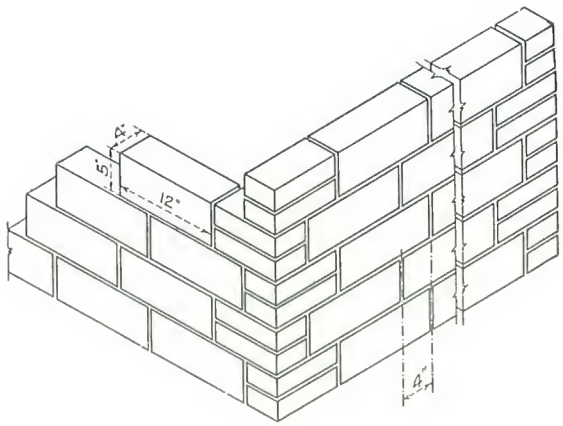


Fig. 112
Common brick used for corners and openings on side construction 4" wall.

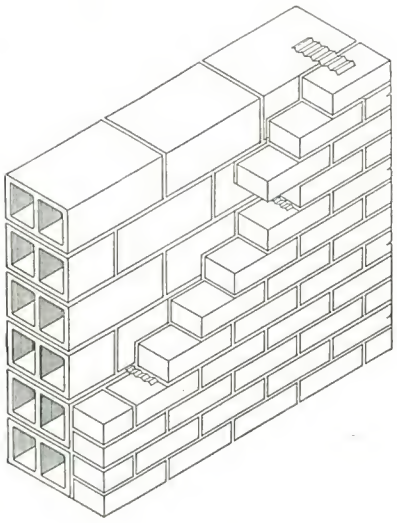


Fig. 952
8" tile wall, side construction with brick facing.

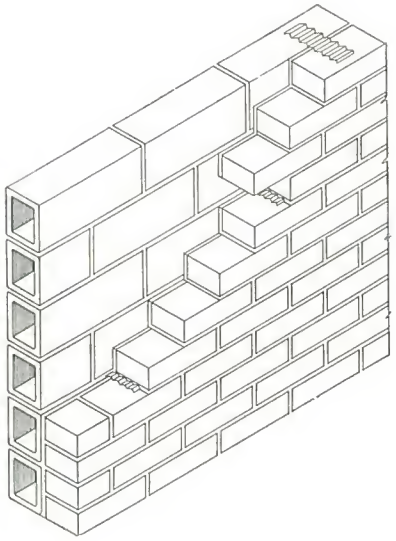


Fig. 955
4" tile wall, side construction with brick facing.

Bonding with metal ties is only recommended for light structures.

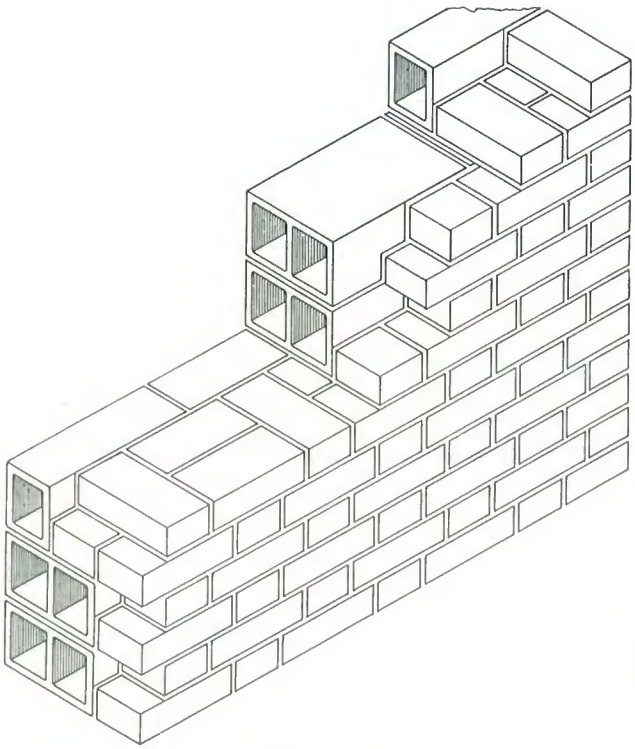


Fig. 1026
Shows an 8″ tile wall, side construction, with Flemish bond veneer. Full headers occur in every fifth and sixth course.

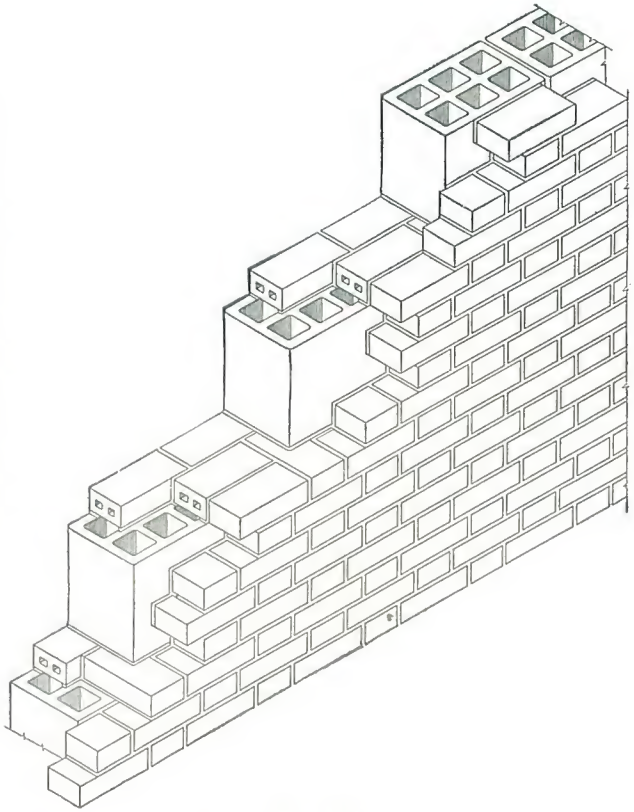


Fig. 951
Shows an 8″ tile wall with end construction tile cut to bond with brick veneer, Flemish bond, with brick headers every fifth course.

WATERPROOFING THE CELLAR

Cellar walls of Hollow Tile may be waterproofed by the coating method, unless they are plastered by integrally waterproof cement mortar. A properly built dry drain is the best assurance of a dry cellar.

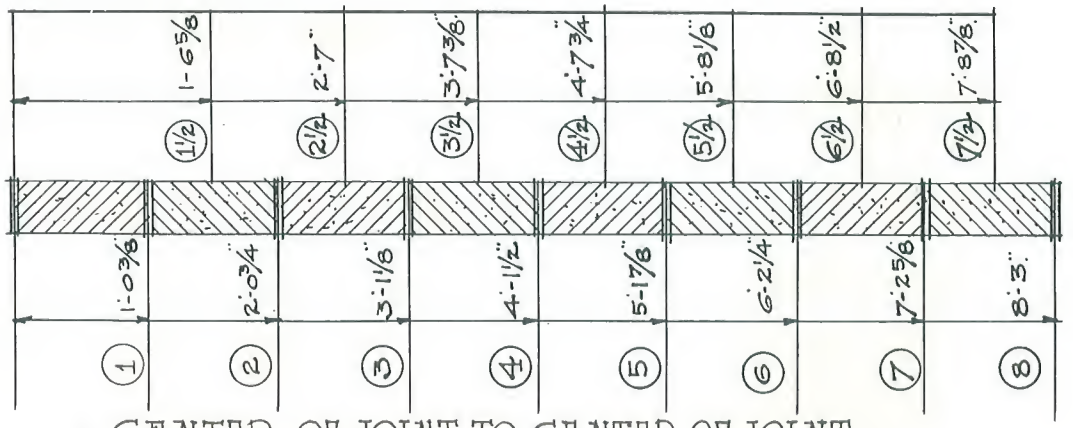
Top of drain should be at least 1″ below lowest point of cellar floor. Drain may be laid practically level but discharge from same should have a good fall.

Hollow Tile cellar walls are generally waterproofed with Portland cement mortar which may be coated with any good waterproofing compound. The best way to use these preparations is to rough plaster the wall just enough to cover the keys in the tile, then apply the waterproofing coat, following with a protecting coat of Portland cement mortar ¼″ thick while the waterproofing is still plastic.

Damp-proof coatings must cover every inch of surface, as a hole no larger than a pin head will cause trouble if any quantity of ground water is present around the foundations.

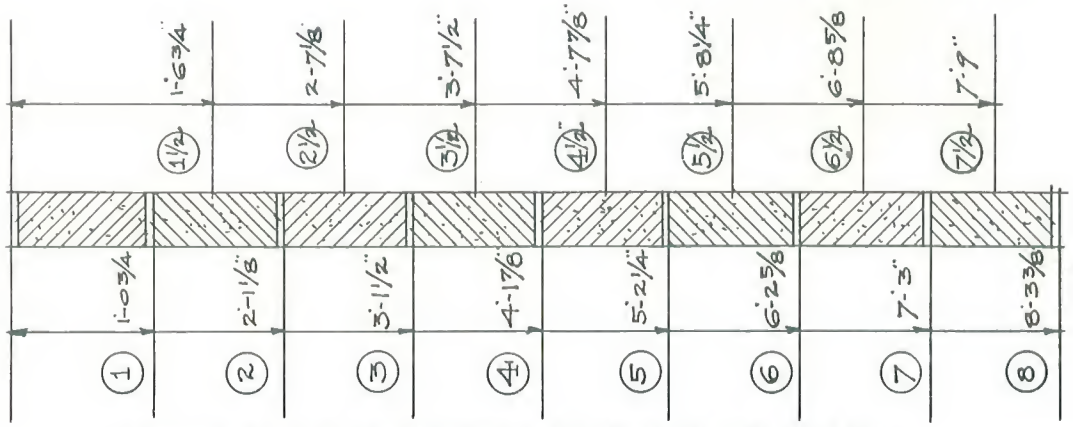
Backfill carefully; avoid sharp stones or injury to the waterproof coating.

Slope ground away from building and plant grass seed.



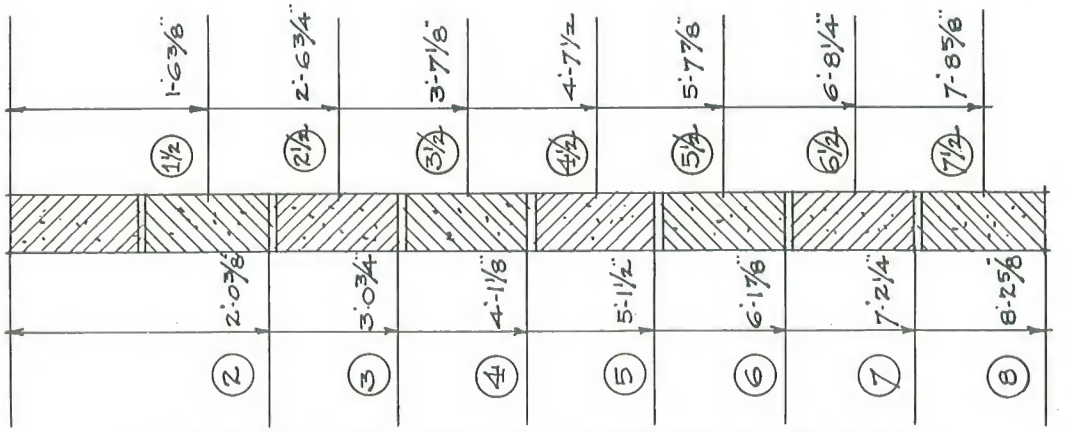
- CENTER OF JOINT TO CENTER OF JOINT -

FOR WALL MEASUREMENTS.



OUTSIDE OF JOINT TO OUTSIDE OF JOINT -

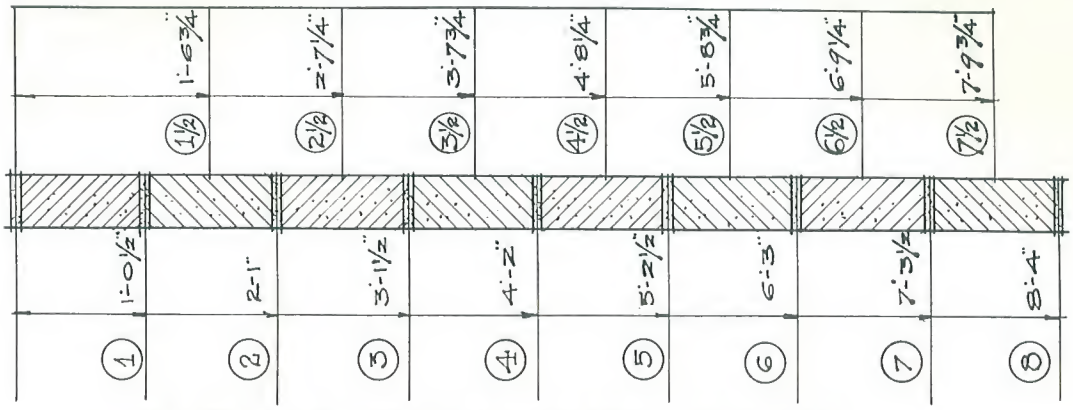
FOR WIDTH OF SINGLE OPENINGS.



"OUTSIDE OF PIER TO OUTSIDE OF PIER."

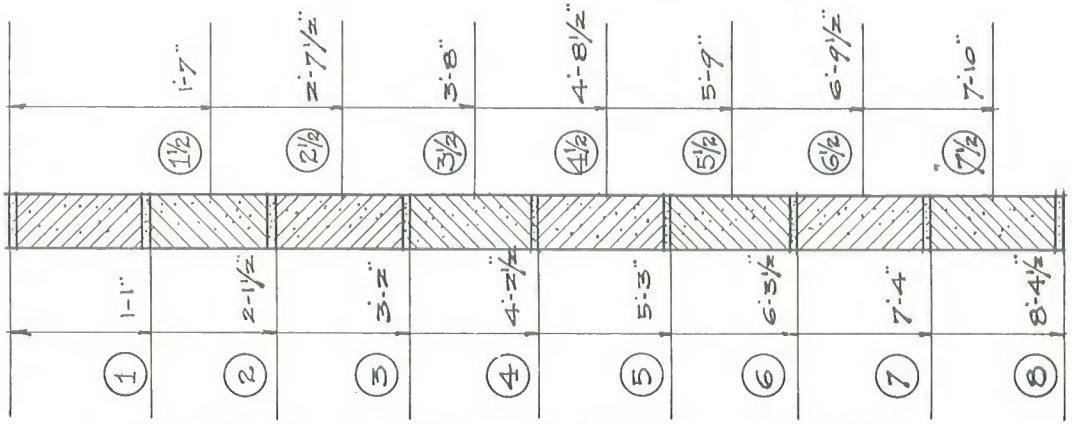
- BASED ON 3/8" JOINTS -

Fig. 203
Table showing widths for openings, piers, etc., for both side and end construction tile units.



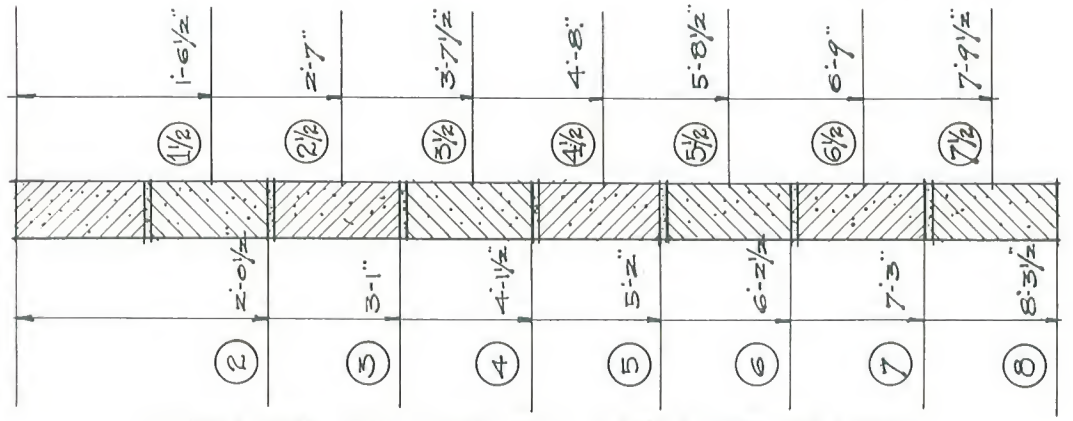
- CENTER OF JOINT TO CENTER OF JOINT -

FOR WALL MEASUREMENTS.



OUTSIDE OF JOINT TO OUTSIDE OF JOINT

FOR WIDTHS OF SINGLE OPENINGS.



OUTSIDE OF PIER TO OUTSIDE OF PIER

- BASED ON ½" JOINTS. -

Fig. 200
Table showing widths for openings, piers, etc., for both side and end construction tile units.

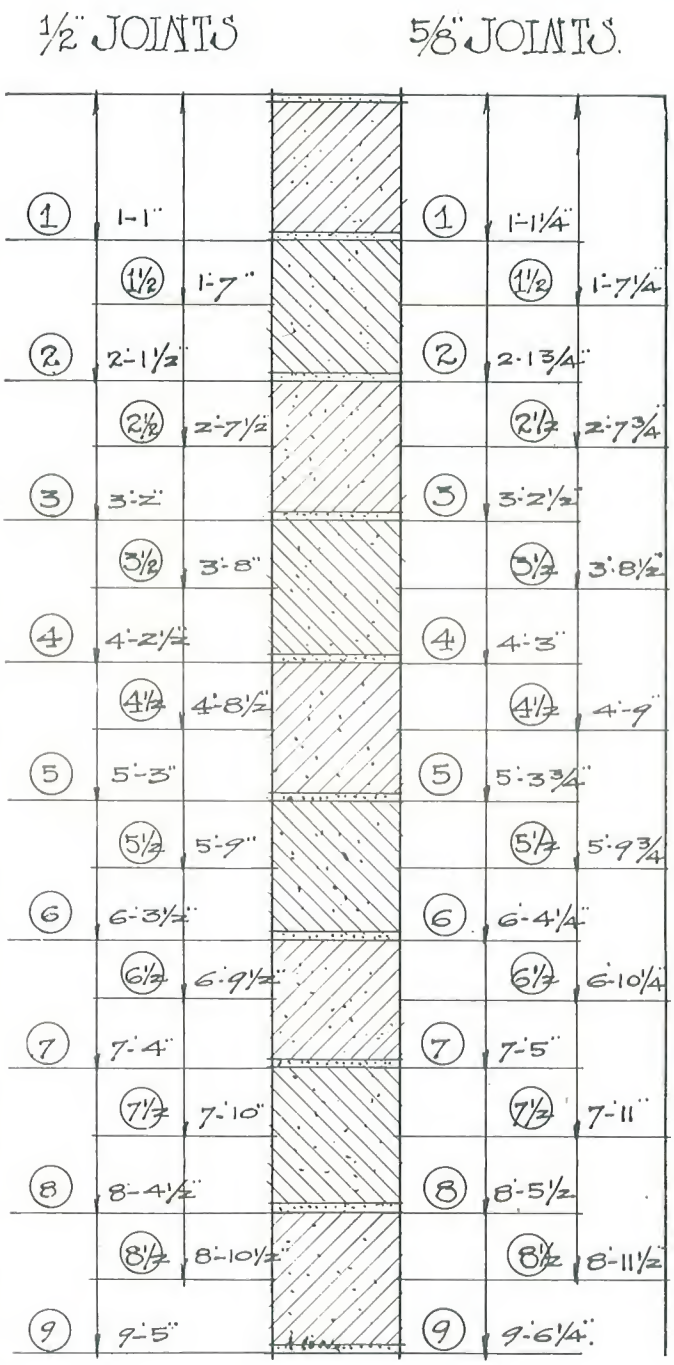


Fig. 201
Table showing clear heights of openings in hollow tile walls for both side and end construction using 12" course.

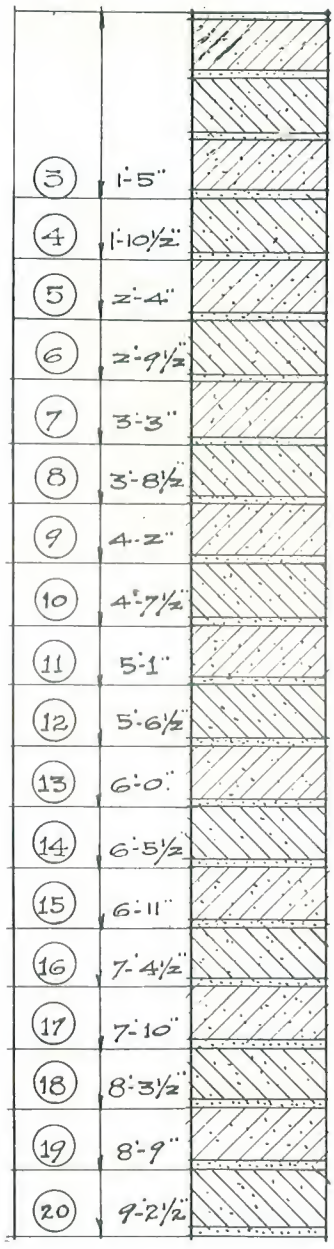


Fig. 201-A
Table showing clear heights of openings in hollow tile walls for side construction using 5" course.

FOUNDATION AND FOOTINGS

For small or moderate sized residences, garages, stores, and similar buildings, Hollow Tile Foundation walls should be used. They have ample strength and are in every way satisfactory. This type of foundation wall gives a drier basement or cellar than the average wall of solid masonry of the same thickness. Hollow Tile foundation walls have been found perfectly dry even in ground that was more or less saturated.

When the foundation walls are built in an occasionally saturated soil, the exterior face should be plastered with a water-proofed coat of cement mortar in order to insure the sealing up of any small openings in the mortar joints.

Such footings afford natural drainage under the foundation, are easy to lay, can be built upon immediately, and have ample strength.

Foundation walls of Hollow Building Tile have ample strength to support the entire superstructure weight with a suitable factor of safety. Its strength has been demonstrated by tests. The data given herewith for the benefit of architects, engineers, or home builders is based on authentic tests.

Hollow Tile foundation walls also have sufficient strength to act as a retaining wall supporting the earth banks and the side pressure exerted by freezing, or from saturated earth. Care should always be taken in the building of a foundation to see that masons thoroughly bed all tile with well-filled mortar joints and that a good dense cement mortar be used. As foundation walls are seldom furred or plastered, the fact that they are free from condensation makes this construction extremely valuable for basements or cellar walls.

Some builders have filled the cells in Hollow Tile foundations with concrete. This is *not* necessary and is not done to strengthen the carrying capacity of the foundation, because it adds very little to the supporting strength, but to add to the dead weight that *may be thought necessary* to provide stability against earth pressure. Hollow Tile insures a strong foundation and a dry, healthful basement or cellar.

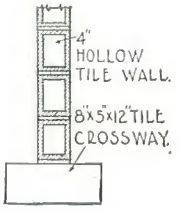


Fig. 915-B

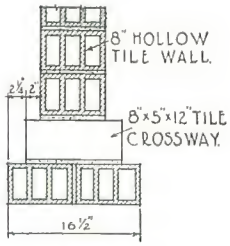


Fig. 915-A

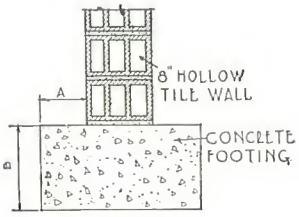
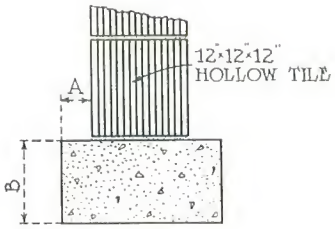


Fig. 915-C



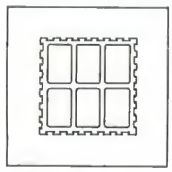
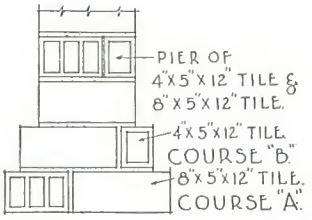
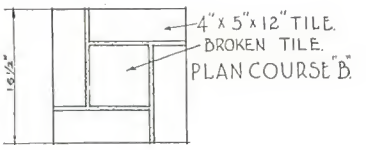


Fig. 1051





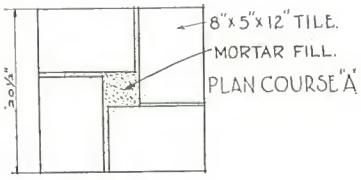


Fig. 919

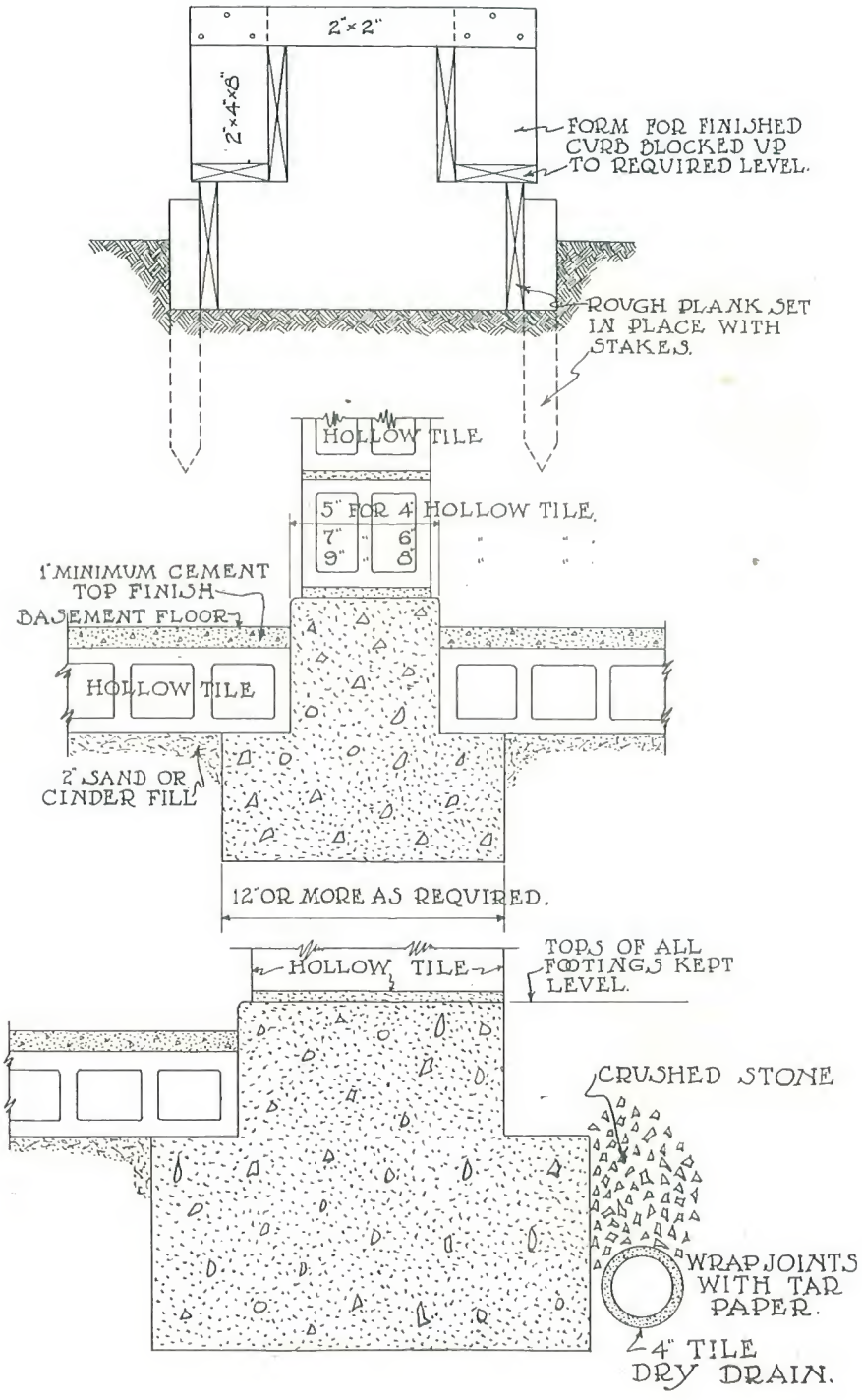


Fig. 985
Typical detail of concrete footings for tile walls and method of building forms.

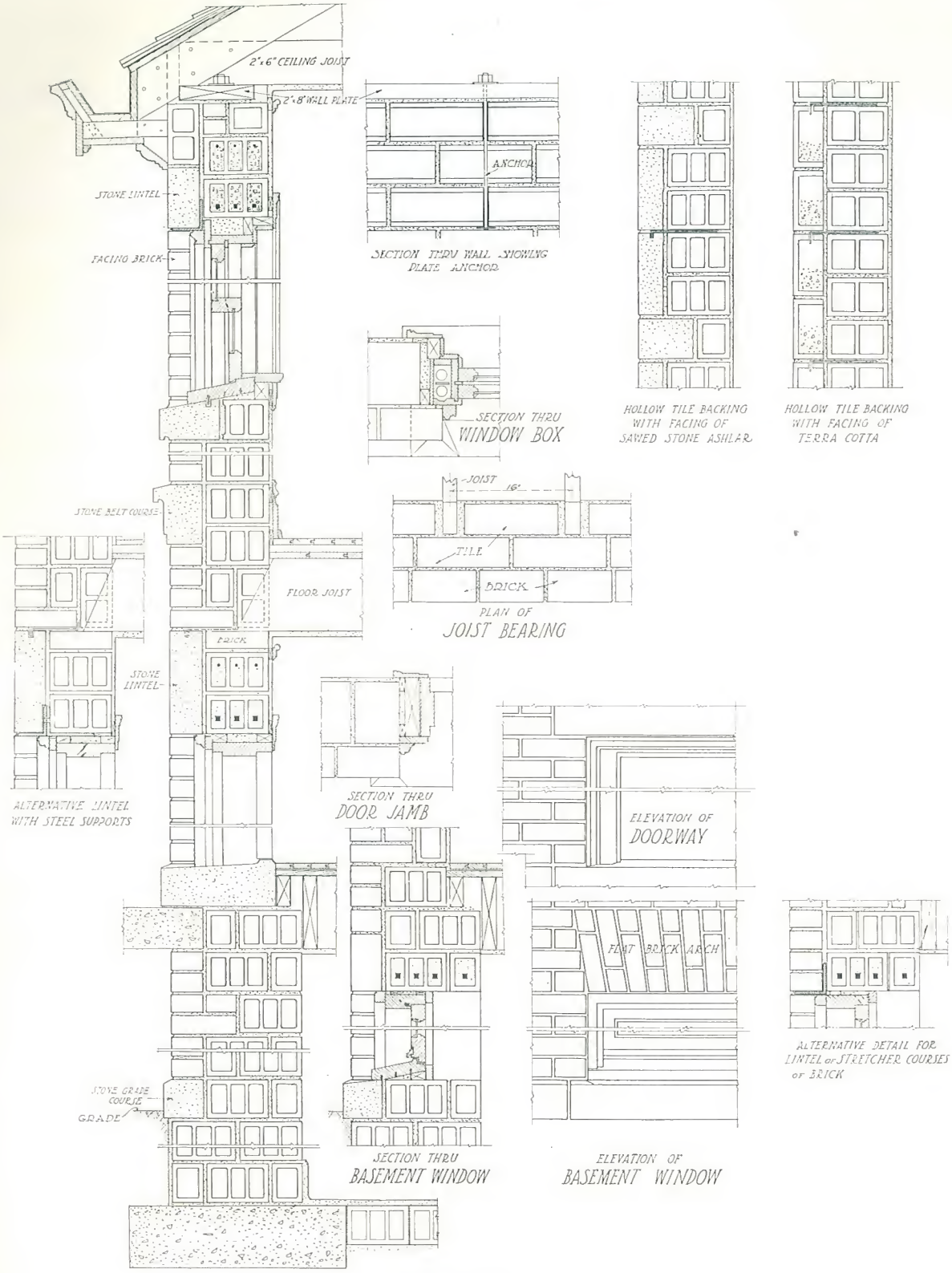


Fig. 1055

Typical Section Through Hollow Tile Wall with Brick and Stone Veneer

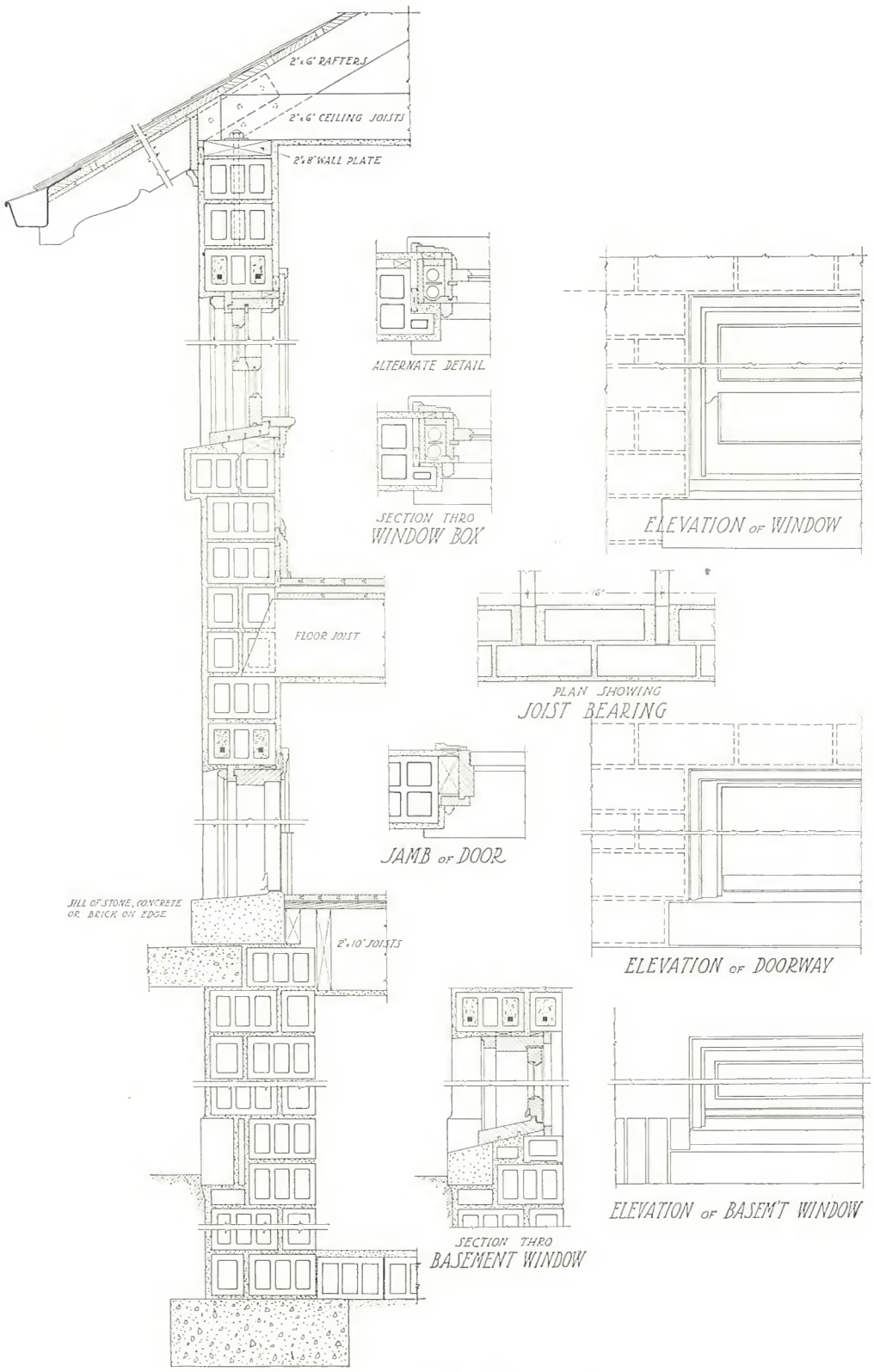


Fig. 1053
Typical Section Through Stuccoed Hollow Tile Wall, Side Construction

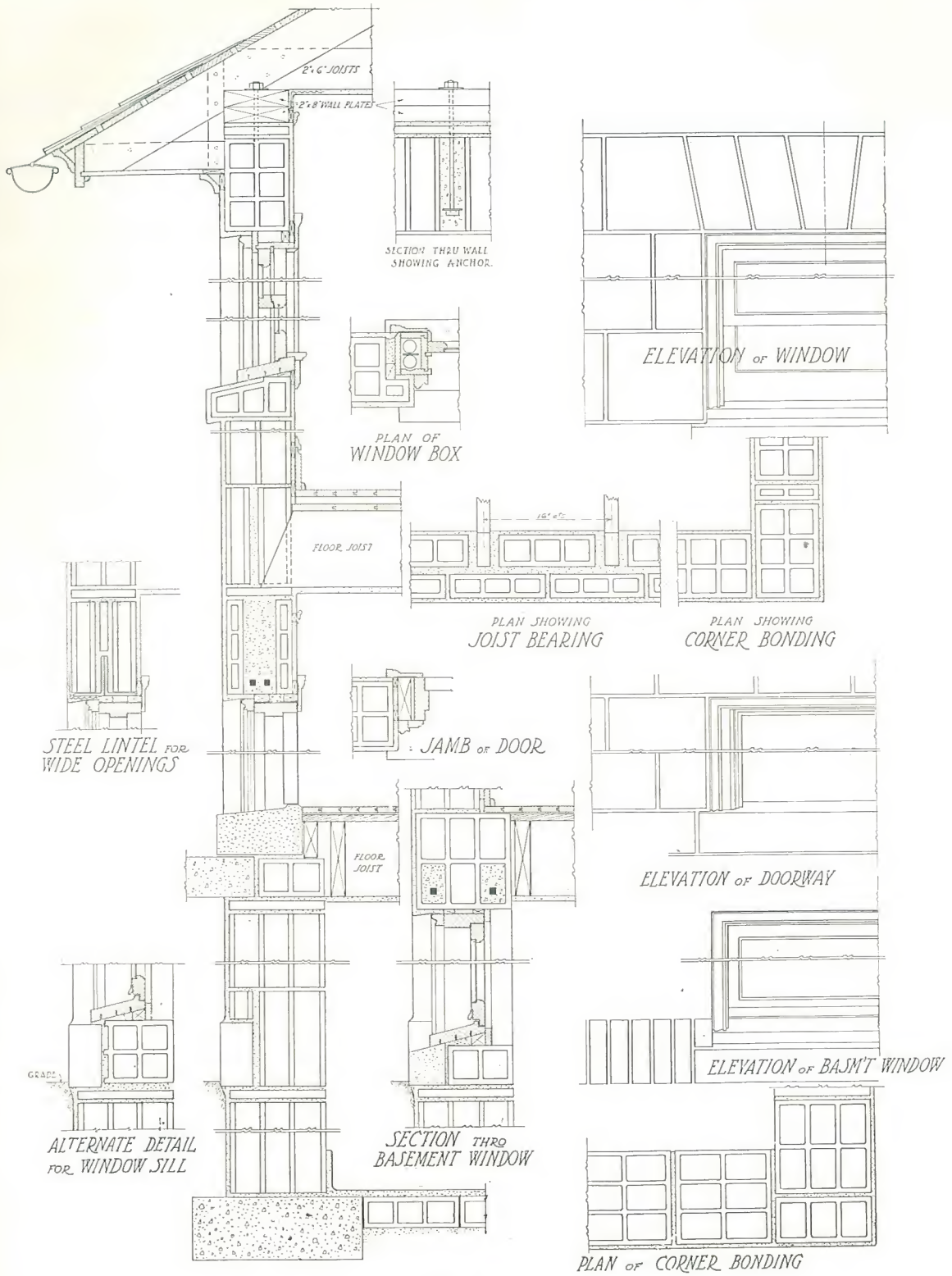
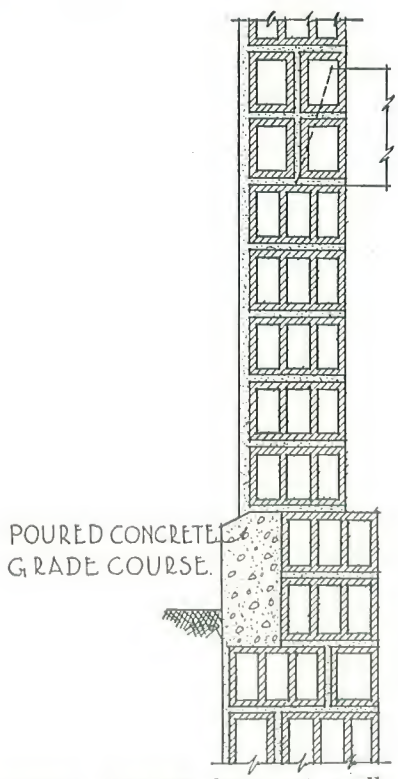


Fig. 1054
Typical Section Through Stuccoed Hollow Tile Wall, End Construction



Section through basement wall showing method of building water-table course.

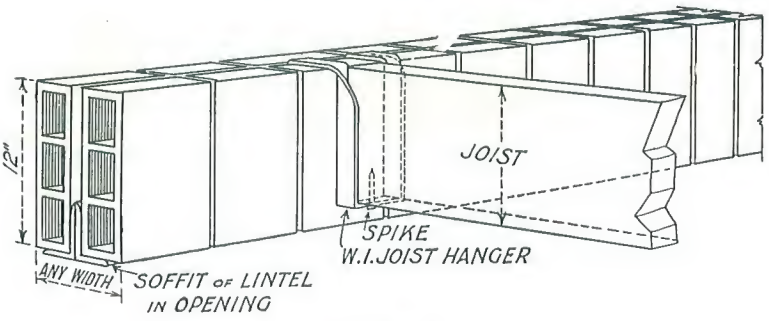


Fig. 978
Method of supporting floor joist by means of joist hanger where joist occurs at window or door lintel.

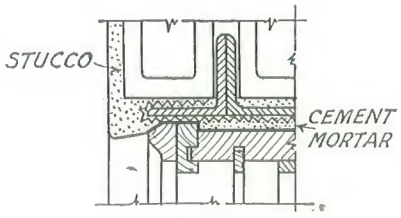


Fig. 978-A
Steel angle iron lintel supporting Hollow Tile.

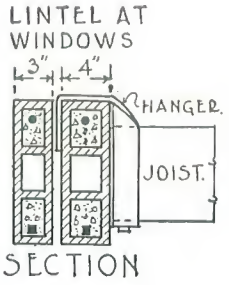


Fig. 977-A
Section through window or door lintels showing the use of joist hangers.

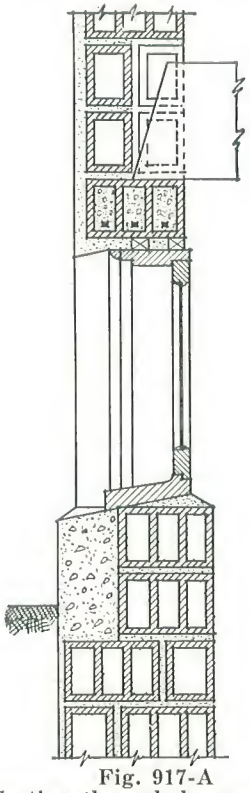


Fig. 917-A
Section through basement window showing method of building window sill.

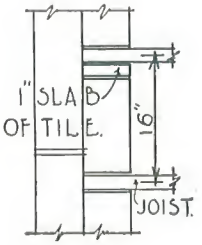


Fig. 917-B
Plan showing method of filling in between joist.

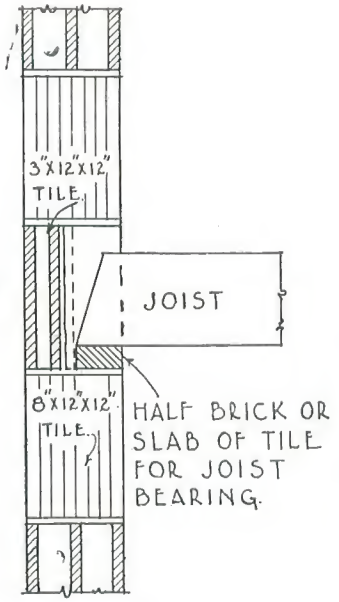


Fig. 977
Section through wall showing joist bearing on 8" end construction tile wall without slab course.

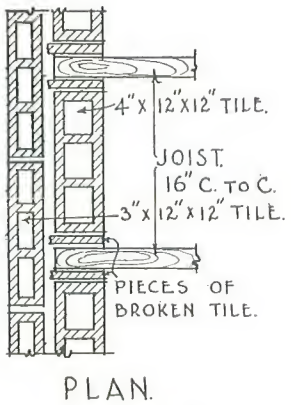


Fig. 977-B
Plan through wall showing fillers or blocking between joist.

OPENINGS IN WALLS

Hollow Tile wall construction retains the strength and other characteristics inherent in the material or units of which it is built.

Jambs, piers or mullions are capable of supporting the extra dead weight and other loads transferred by the lintels or arches which span the openings. Tile has a margin of safety that makes this strength a certainty. The jambs may be flush, set out or recessed as desired. Hollow Tile lintels or arched openings properly constructed are sufficient to carry both the dead and live loads that occur at this portion of the wall without appreciable deflection and transmit these loads over a suitable bearing area of the jamb, pier or mullion.

The wall or piers are also effectively tied together over the opening. Structural steel shapes are unnecessary except over the very wide openings and the need for strong arches, keystones and trimmer beams is done away with. It is equally practical to provide for arches, pannelled tympanums, recessed spandrels, flower boxes or balconies, with or without special material, and without impairing the structural details and their necessary carrying capacity.

Hollow Tile construction provides a joint around frames that is wind tight regardless of the shrinkage of the wood frames. Whether frames are set in reveals or within a straight jamb it is an easy matter to render the joint between frame and wall air-tight and secure in the anchorage of the frame. The details on pages 37 and 38 indicate how this is done. Reinforced tile lintels are the simplest, cheapest and most practical that can be used. These lintels when placed in the wall simply continue the regular coursing of the tile.

With Hollow Tile walls there is no leakage around the window sill when tile are properly set, and the sill provides its normal functions both architecturally and structurally. The sills may be of Hollow Tile finished the same as the balance of the wall or any desired type of sill may be used such as stone, brick (flat or on edge), terra-cotta, cast concrete or other material.

Door sills may similarly be of various types and materials, stone, brick or concrete generally being used. The very fact that the opening may be constructed of the same material that is used for the walls makes this form of construction economical. Either wood or metal frame windows may be used.

In one day a single laborer should prepare all of the lintels required for the average small residence or commercial building.

THE WALL SUPPORT OF FLOORS

The wall of Hollow Tile is so constructed that pockets for joists may be built into them with practically no reduction in the bearing area, also that provision for the proper bedding of these joist, or beams and the distribution of the load is taken care of by the bonding of the tile units.

The tile fits tightly about the ends of the joist so there is no opportunity for side movement which makes the floor rigid.

There is no cutting required to provide for floor bearing on Hollow Tile walls. In vertical construction a bearing plate or slab of tile is used and the load is thus immediately distributed over a considerable bearing area. Joists should always have a wall bearing of at least 4″ and should have a 3″ fire cut.

This insures a bearing on at least two of the longitudinal members or about 3 sq. in. of shell and web area.

As the minimum carrying capacity of the tile must equal 1,525 pounds per sq. inch, net area, this provides a bearing value of 4,575 pounds under each joist end.

This provides for a load impossible for any ordinary 2″ joist to carry, even if spaced 12″ on centers for a floor load of 100 pounds per square foot.

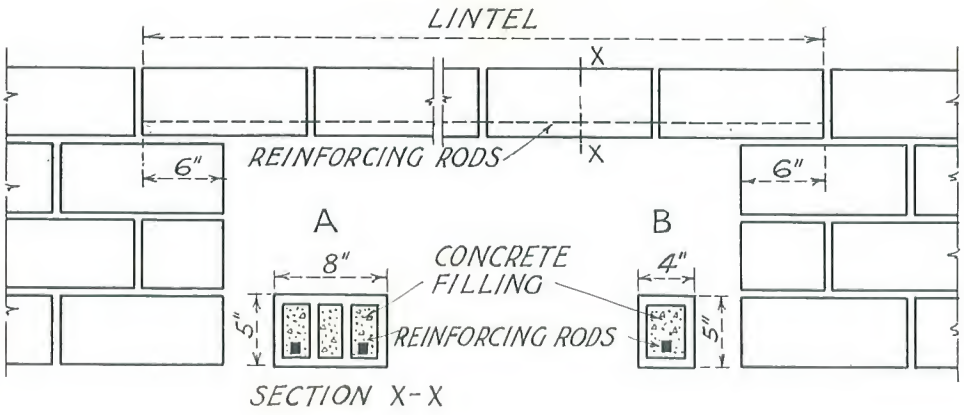


Fig. 910

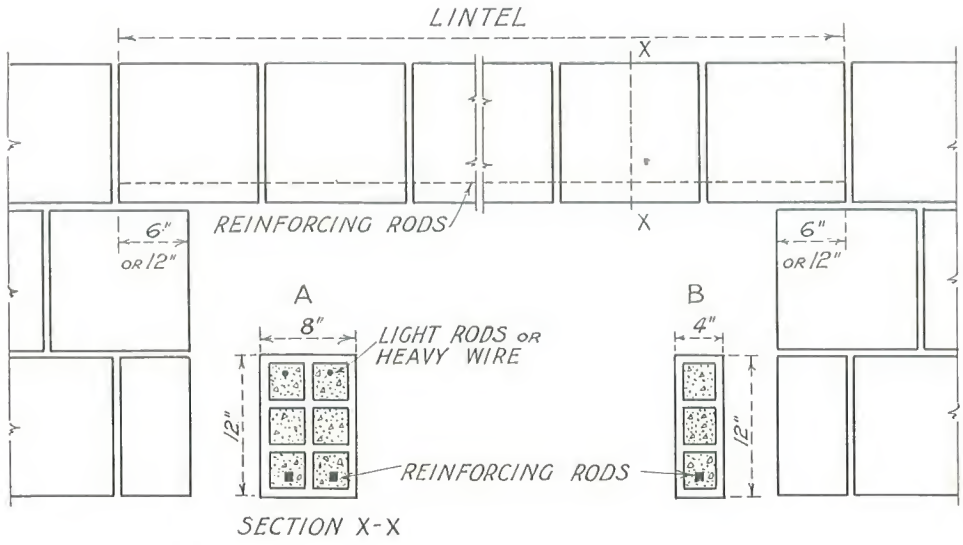


Fig. 911

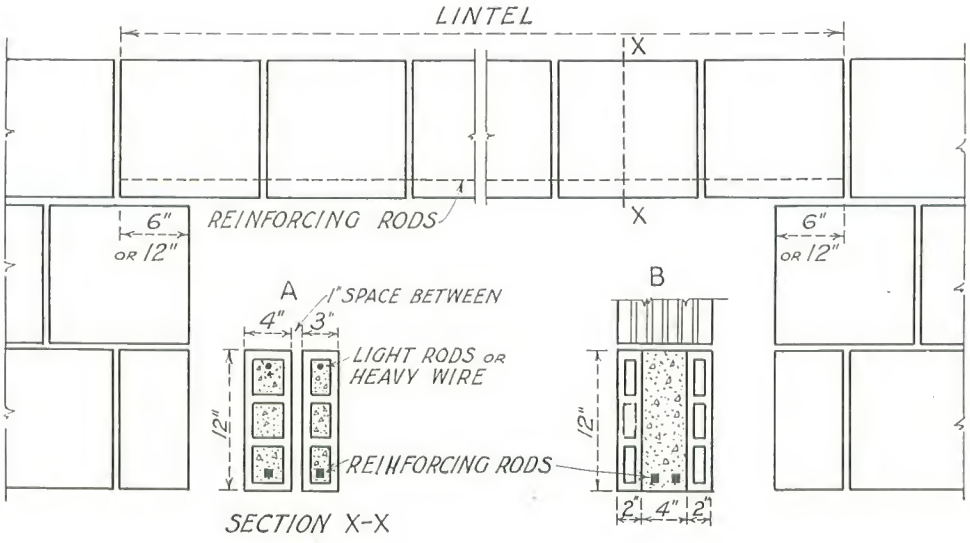


Fig. 912

REINFORCED TILE LINTELS

Construction of Hollow Tile lintels with the use of concrete and reinforcing steel is a very simple problem, as shown by the accompanying illustrations.

There are two methods of building these Hollow Tile lintels. One method is to place the tile on end upon a board or other level surface, each piece of tile over the other with a mortar joint between so as to get a perfect bearing. Place the required amount of reinforcing steel in the cells which will occur at the bottom of lintel when it is installed in the wall, and then fill all of the cells with concrete. After the concrete has set this lintel can be hoisted bodily, either by hand if it is a short lintel, or by employing a gin pole, and set in its place upon the wall. When this latter method is employed a light rod must be placed in the top cells to provide for the tension while lifting the lintel in place.

The other method is to frame the opening requiring the lintel, either by bracing the head of the window frame or by the use of a plank, and lay each piece of tile in place. Place the reinforcing steel, and then fill the cells completely with concrete. An easy way of filling the cells when the tile are in this position is to take a trowel or bricklayer's hammer and clip the horizontal top shell and intermediate webs at each joint so as to allow the concrete to be poured into the lintel from each joint instead of shoving and ramming the concrete the half length of the lintel. Then proceed with the wall and later on remove the props or shoring.

In figuring the carrying capacity or safe load which a reinforced Hollow Tile lintel will support, the compressive strength of Hollow Tile and concrete must be taken into consideration. Hollow Tile in compression will sustain a greater load than limestone concrete at the age of 60 days. The reinforcing steel in tension will remain constant for a given load in both materials. The bond set up by the cement between Hollow Tile and concrete is excellent. Therefore, in figuring the carrying capacity of a Hollow Tile lintel, the cells of which are filled with concrete, and with an equal area of reinforcing steel, it is safe to use accepted engineering formulae for a reinforced concrete lintel. The extreme sizes of Hollow Tile to be taken as the sizes of the beam or lintel.

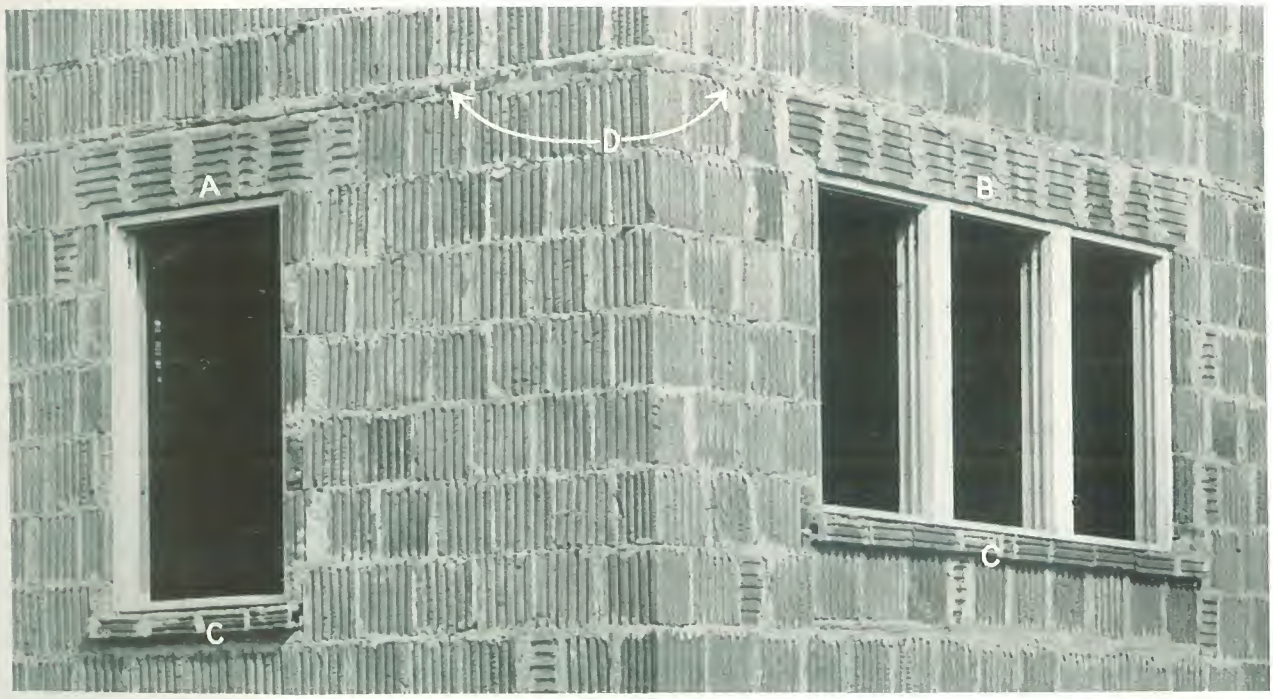
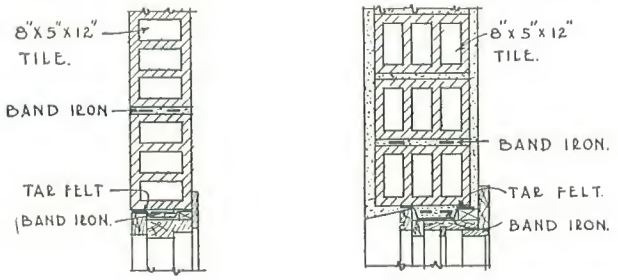


Fig. 997-A
Detail at corner of Hollow Tile Wall showing both (A) ordinary and (B) wide reinforced lintels over single and triple windows. Hollow Tile sills (C) and Tile slab course (D) forming joist bearing for the floor above in walls of end construction.

Fig. 1056
Bedding Reinforced Tile lintel over door opening in Hollow Tile Wall. Reinforced lintels may also be built on the wall avoiding the use of gin pole and tackle where wide or heavy lintels are required.

SIMPLE TILE LINTELS



"A"
8"X5"X12" TILE SET ON EDGE

"B"
8"X5"X12" TILE SET ON SIDE

Hollow Tile walls for garages, poultry houses, in fact for any minor building or other simple structures, in which the window openings are small and the walls frequently only 4″, 5″ or 6″ in thickness, may be built without specially reinforced lintels if the wall is reinforced by band iron bedded in the joints over window and door openings.

This band iron reinforcement should be placed in two joints; in the one immediately over the wood frame, and in the joint above the first course of tile over frame.

Band iron should be well bedded in the cement mortar joints throughout its length and extend for at least 18″ on each side of opening.

Band iron reinforcing should be from No. 16 gauge up to ⅛″ in thickness and ¾″ to 1″ in width. Several lines of heavy soft steel wire (No. 4, 6 or 8 gauge) in each joint may be used in similar manner, or the regular woven wire reinforcement may be used.

Whenever cement mortar or concrete is placed directly on top of the wood frame as required in this form of lintel construction, a strip of tar paper should be placed over top of frame to prevent absorption of moisture from the mortar or concrete and the probable swelling or warping of the frame.

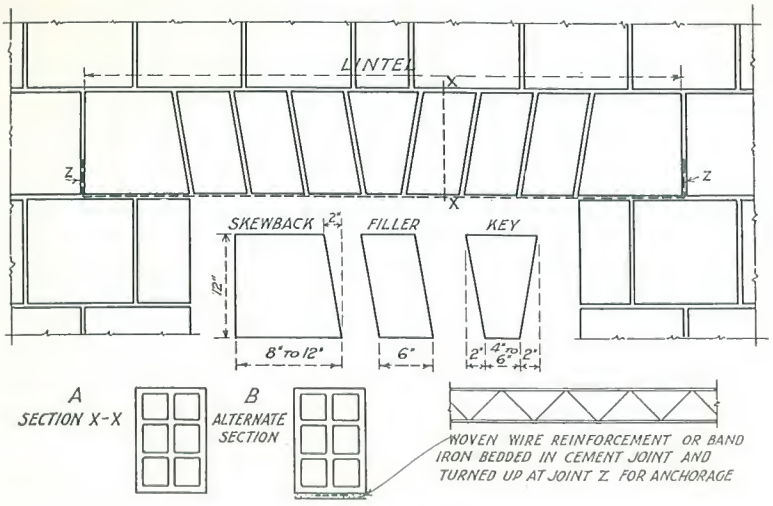


Fig. 960

FLAT ARCH LINTELS

For all lintels over single windows or doors in walls built of any tile having courses eight inches or more in height, the simplest form of lintel is the flat arch cut from the same tile that is used in the wall, as shown by Figure 960.

Heads of frames should be temporarily braced with this form of lintel, which also should always have proper abutment to resist the thrust. These flat arch lintels therefore should not occur too close to the corners of walls or be supported on slender piers. The corner piers should not be less than three feet wide.

In all cases where they must be used near corners, a reinforcing tie of strap iron or woven wire should be bedded in cement mortar in the joint beneath, as shown by Figure 960, and be turned up into the vertical joints for anchorage.

The flat arch lintels are not used extensively because the shapes required are not carried regularly in stock by the dealers, and by some manufacturers are only made on order.

This form of lintel has many advantages for the short spans which occur in residence buildings. They are light and easy to set, no previous preparation, reinforcing or concrete filling is required, they retain the insulation feature of the hollow wall, and, with the three shapes shown, a lintel of any length in steps of six inches can be built by varying the number of fillers used. Special length lintels are not required for the different widths of openings.

The cost of such lintels is slightly more than the regular square foot price of the tile shapes from which they are made, when ordered along with the straight wall tile.

We recommend the use of these lintels for ordinary floor loads and spans with wood beams, on spans not to exceed 5′ 0″.

The corner piers should ordinarily not be less than 3′ 0″.

The following is a formula for finding the thrust of the flat arch lintel.

Assume—Live load on floor..... 60 lbs. per sq. ft.
Dead load of 10″ + 2″ combination floor..... 80 lbs. per sq. ft.
Total load.....140 lbs. per sq. ft.

Span of floor 16′ 0″. Weight of wall panel over window including weight of lintel 100 lbs. per lineal foot.

p = thrust of arch in lbs.
w = load on arch per lineal foot = 1220 lbs. in this case.
From page 80 a 12″ flat arch is good for 3′ span.
L = span of lintel in feet.
R = effective rise of arch in inches = 2.4″ less than the depth of tile = 9.6″ for 12″ depth of tile.

$$p = \frac{3\ w\ L^2}{2\ R} = \frac{3 \times 1220 \times 9}{2 \times 9.6} = 1734 \text{ lbs.}$$

Assume height of window 6′, then overturning moment 1734 x 6′ = 10404 ft. lbs.

Stability moment against overturning .....1830 × 3 = 5490
2610 × 2 = 5220
10710 ft. lbs.

As an additional factor of safety we have the shearing value of the tile above the lintel level.

By reducing the floor load the span of lintel can be increased, but the pier should not be much less than 3′ 0″ where the floor load is carried on the lintel.

CAULKING OF FRAMES

A great many architects will prefer to have all window frames caulked in order to eliminate all chance of air leakage around window frames. In some instances caulking is more necessary for another purpose, that of preventing water finding its way through the wall around back of frames, during driving rainstorms.

Frequently in cases where dampness has been noted on the wall around windows the blame has been placed on the Hollow Tile, whereas it was due solely to poor workmanship in setting of window frames and ceased to exist or occur as soon as the frames were made tight.

Wood frames will shrink somewhat and caulking undoubtedly improves any building and is recommended in all northern sections of the country, although not usually done in ordinary residence and commercial work.

If caulking is to be done properly, a groove for it should be provided as it cannot be done properly in cracks that are so narrow that it can only with difficulty be forced in with the edge of a knife.

Reference to the window frame details shown in the various cuts will indicate that provision for caulking has been made in every instance and it may be either included or omitted without changing any of these details.

The method of frame anchorage and very effective wind stop recommended makes caulking less necessary than when frames are set in the ordinary way.

When caulking is done with oakum use the oakum dry. If soaked in oil or other substance containing grease, it will stain the stucco.

When setting double-hung window frames in Hollow Tile walls, allowance should always be made for the reduction in size of rough opening after stucco is applied. The back of staff beads should be kept from ¾″ to an inch or more free of the face of tile in jambs of openings as shown on pages 37 and 38. This is particularly true of stock frames which have the staff beads nailed on permanently, but even with specially made frames with loose staff bead this rule should be followed. The best way to accomplish this is to lightly tack a strip on the frame in back of the staff bead and build the tile to these strips which are removed after the tile is set. The stucco is then run in back of the staff bead and up to the face of the frame and finished neatly around the frame with an air-tight joint. Even when separate staff moulding, as shown on pages 37 and 38 is used the stucco is best run into the face of the outside casing. The old method was to have the staff moulding loose and scribe it to the face of the stucco. This is not necessary and is rarely, if ever, done. An equally tight and satisfactory job can be obtained if the work is done as described and a proper allowance made for the thickness of stucco when the frames are set in the tile walls.

When box window frames are to be used in Hollow Tile walls without the use of jamb tile or other form of construction providing a reveal for the box and the full depth of box must be exposed in the opening, the frames should be ordered with the regular stock staff beads omitted and a wider staff mould used. This moulding should be mounted on the face of the frame with the back about flush with the back of the box.

If a staff bead must be used to form banding reveal for storm sash and outside screens, then a special staff bead the full depth of the box should be ordered. Generally a 3″ or 3½″ wide staff bead will be required in such a case.

Where the window frames are specially made they can be detailed for this requirement, somewhat like the frame shown by Fig. 993 on page 37.

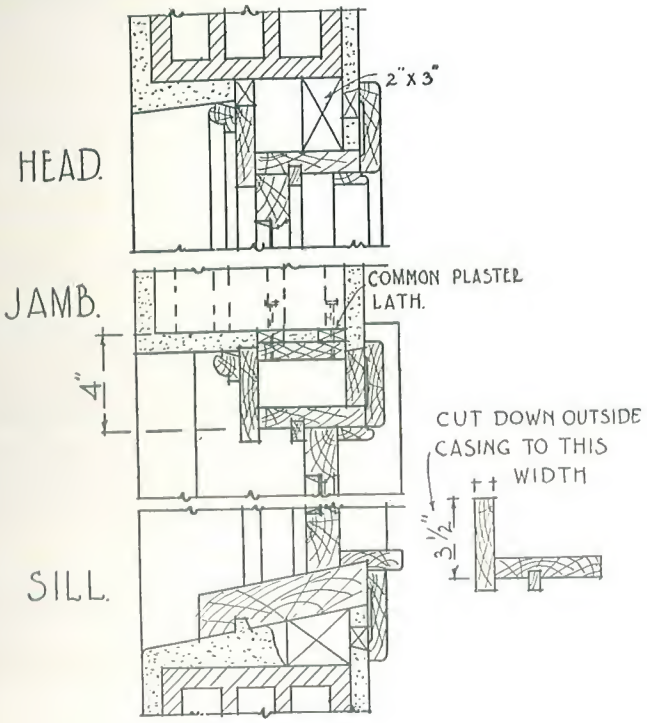


Fig. 993
Typical detail of method for setting common stock window frame in hollow tile walls without jamb tile.

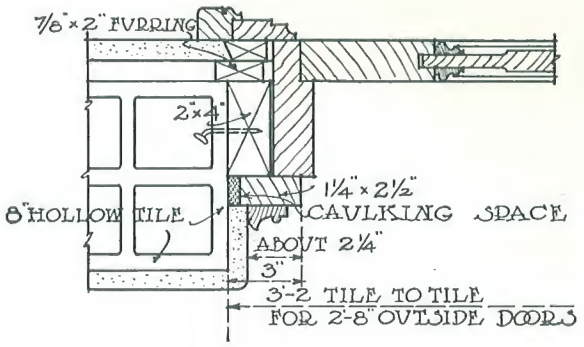


Fig. 991
Typical door frame detail with hollow tile walls, using rough pine bucks for all exterior doors.

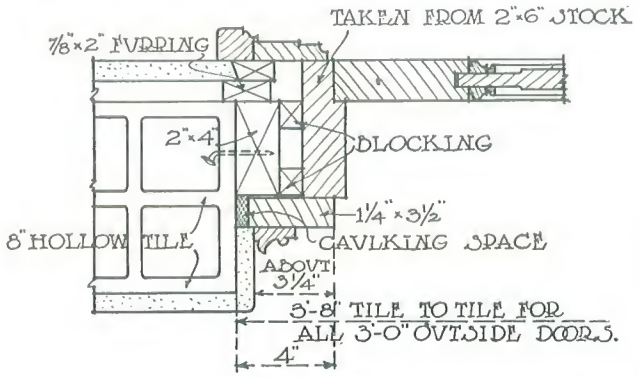


Fig. 991-A
Typical door frame detail with hollow tile walls showing method of obtaining larger door openings.

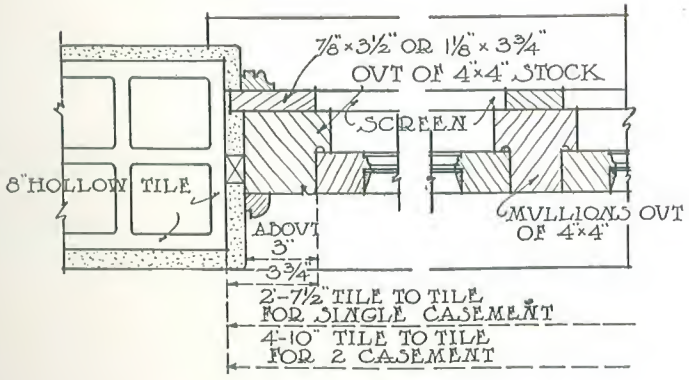


Fig. 988
Detail of outswinging casement sash in moulded plank frame.

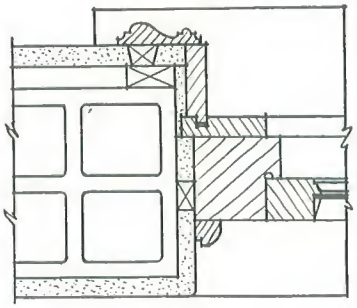


Fig. 988-A
Alternate detail of outswinging casement sash for finished jamb and trim.

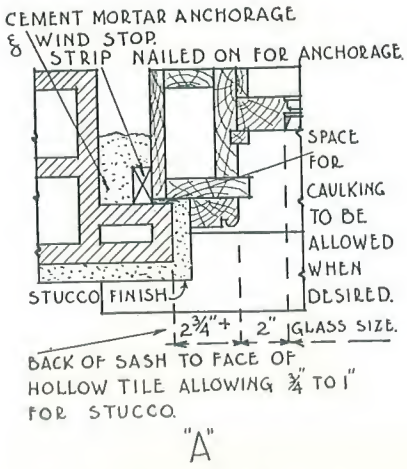


Fig. 990-A
Typical detail of double hung window and jamb tile with stucco finish returned back to frame and without inside trim.

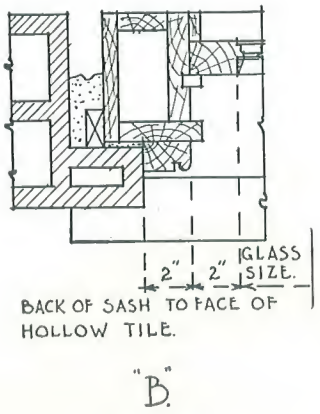


Fig. 990-B
Typical detail of double hung window and jamb tile without stucco finish and without inside trim.

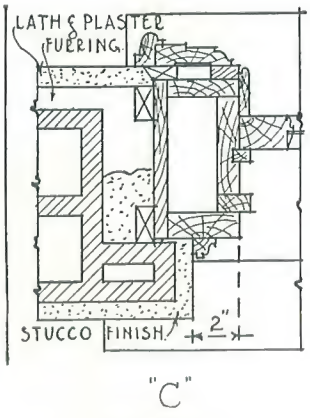


Fig. 990-C
Typical detail of double hung window and jamb tile with stucco finish returned back to frame and with inside trim.

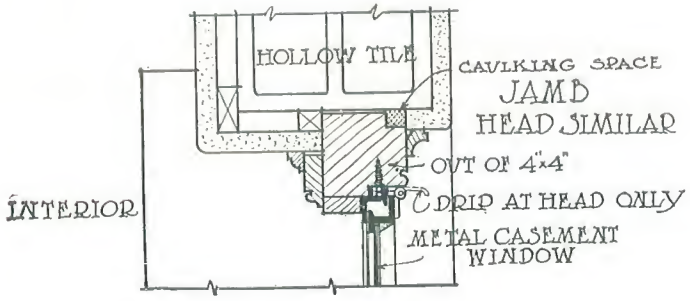


Fig. 992-A
Typical detail of jamb and head showing method of setting metal casement in wood frame for residence.

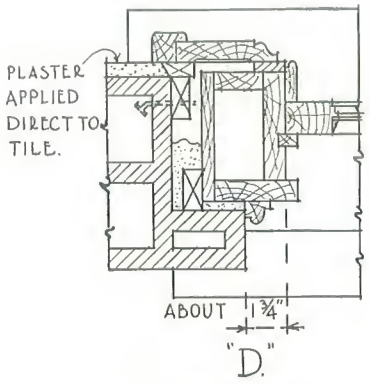


Fig. 990-D
Typical detail of double hung window and jamb tile without stucco finish and with inside trim.

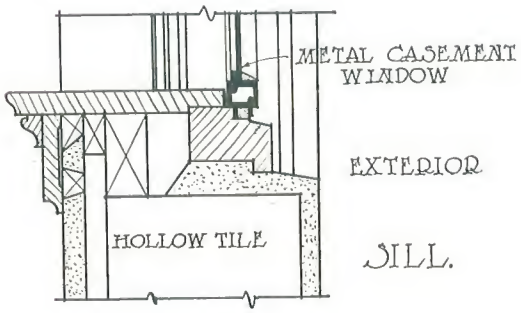


Fig. 992
Typical detail of sill showing method of setting metal casement in wood frame for residence.

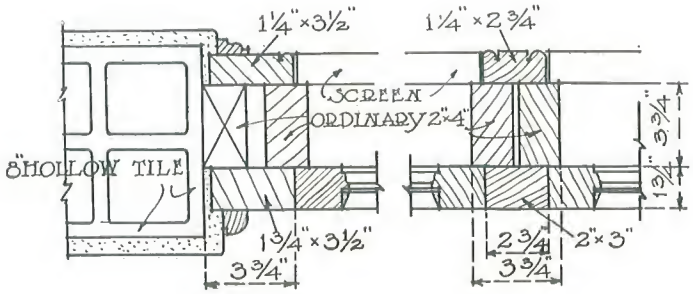


Fig. 989
Typical detail of outswinging casement sash in frames of 2" x 4" studs.

STANDARD WINDOW OPENINGS

The following table of glass sizes can be used to the best advantage, so as to avoid excessive cutting of the hollow tile.

The size of the sash opening will be 4″ wider and 6″ higher than the glass sizes for double hung windows and 4″ wider and 5″ higher for casement windows.

DOUBLE HUNG WINDOWS

Glass Size	Sash Opening	Exposed Tile Opening	Stuccoed Tile Opening
16x26	20x58	24x62	25½x63½
28x26	32x58	36x62	37½x63½
34x26	38x58	42x62	43½x63½
42x26	46x58	50x62	51½x63½

CASEMENT WINDOWS

Glass Size	Sash Opening	Exposed Tile Opening	Stuccoed Tile Opening
20x24	24x29	28x33	29½x34½
20x42	24x47	28x51	29½x52½
20x56	24x61	28x65	29½x66½

CELLAR WINDOWS

20x14	24x19	28x23	29½x24½
30x14	34x19	38x23	39½x24½
42x14	46x19	50x23	51½x24½

Note—2″ has been allowed between the back of the staff bead and the inside of the frame for exposed openings. An additional ¾″ has been added all around for stuccoed openings.

Fig. 980
Hollow tile piers, end construction.

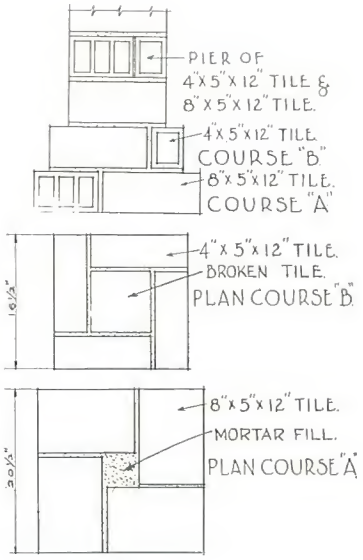


Fig. 919
Elevation of a pier using 4 x 5 x 12 tile and 8 x 5 x 12 tile.

Fig. 994-B
Porch built of Hollow Tile on concrete pier foundation. Note the reinforced beam formed of Hollow Tile carrying the wall and floor construction. These beams are constructed same as lintels shown by Fig. 911 and 912, page 31.

Fig. 995-A
Showing wall built of end construction Hollow Building Tile trimmed with brick belt courses, panels and window framing. Stucco will finish flush with the face of brick which projects approximately 1″ from face of tile.

Fig. 994-A
Showing use of brick for second story belt course and window sills in wall of Hollow Building Tile. Stucco will finish up under and down to brick course.

METHOD OF ATTACHING PORCH OR SHED ROOFS AGAINST HOLLOW TILE WALLS

Note carefully the method of attaching wood porches and similar additions to Hollow Building Tile walls. Bolts or anchors are built into the wall and when wall is completed nailing strip is fastened to face of the wall and the roof or other wood members spiked to these nailing pieces as shown by Figs. 940 and 941. This method is superior to the building of rafters or porch joists into the Hollow Tile walls. Ordinarily ¾″, ⅝″ or ½″ bolts are used and are built in as the wall is erected.

When the bolts are put in after wall is completed a toggle bolt is used if placed in the end joints of tile or an expansion bolt if placed in the side or bed joints, as shown by Figure 942, page 42.

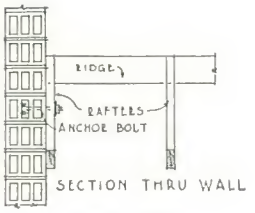
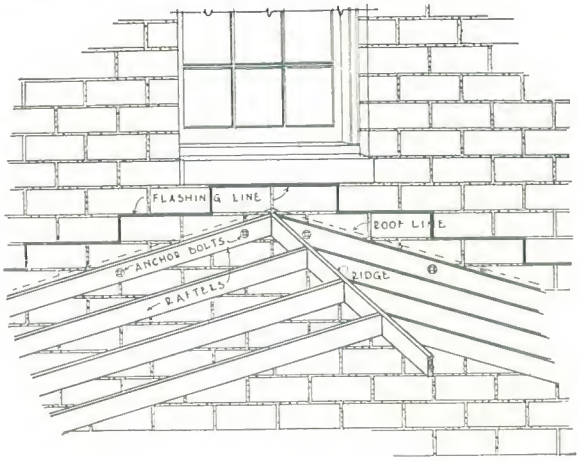
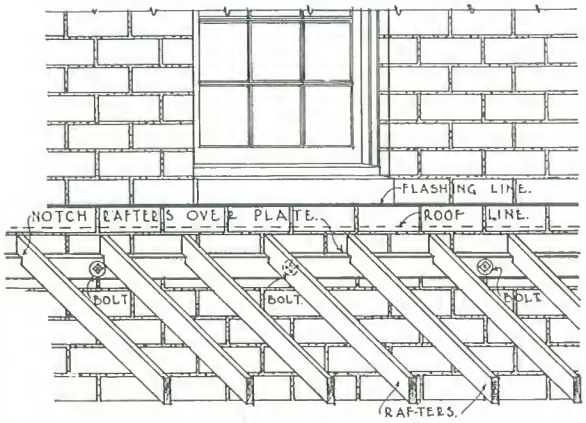


Fig. 941





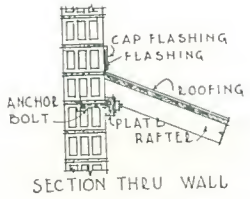


Fig. 940

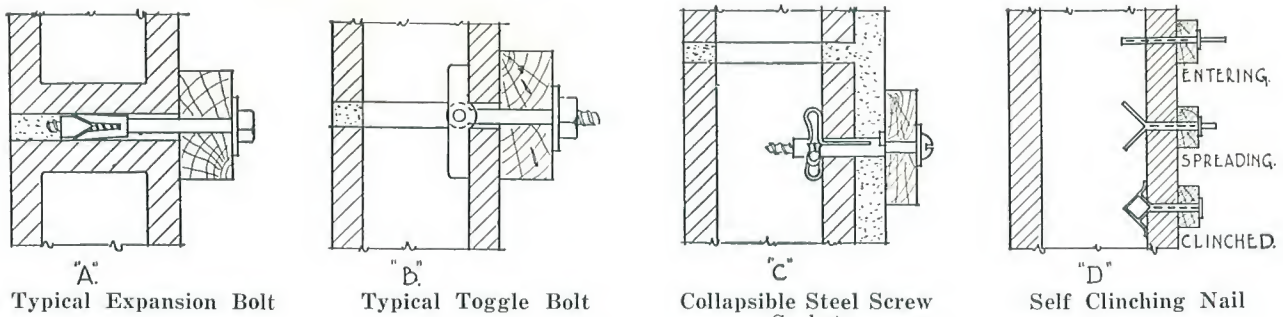
THE NECESSITY FOR GOOD FLASHING

Wherever a roof over a porch or a lower gable roof comes in connection with hollow tile walls, flashing must be provided for.

Sheet lead makes a very desirable flashing although heavy gauged galvanized iron, if well taken care of, will answer the purpose.

This flashing should extend up the tile wall at least 6″ or up to and into the first horizontal joint and should then be brought down over the shingle roof or prepared roof at least 6″, as shown in Fig. 940 and 941.

This will make a permanent water tight joint as long as the flashing lasts which, in the case of sheet lead, is indefinite; but in the case of galvanized sheet iron care must be taken to keep the exposed surface well painted.



"A" Typical Expansion Bolt — "B" Typical Toggle Bolt — "C" Collapsible Steel Screw Socket — "D" Self Clinching Nail

Fig. 942
Various methods of attaching to Hollow Tile Walls.

THE FASTENING OF FURRING, GROUNDS AND NAILING BLOCKS

Wood nailing blocks should never be built into Hollow Tile walls. They are not necessary.

Metal wall plugs may be built into the cement joints of the wall when the tile is erected, but except for base-board, chair rail and picture moulding they are of questionable value. They never seem to be built in the right places and unless a lot of previous study is given to their placing (with consequent loss of mason's time) they had better be omitted and some other form of attachment used.

Furring strips may be fastened with expanding or "self-clinching" nails, driven into a hole in the end joints of the tile wall, or collapsible steel screw sockets may be used. Such furring strip will also serve as a nailing base for the wood trim. When the walls are not furred and lathed, a furring strip should be attached to the tile wall by means of one of the foregoing methods to secure a proper nailing base for picture mould, chair rail, base course and any horizontal continuous trim. Fastenings of various types are shown by Figure 942.

Floor joists are certain to shrink somewhat across the width and this shrinkage in green lumber may amount to as much as ¾" in a 10" or 12" wide joist. The tile walls cannot shrink and as the base-board is always fastened to the walls, the floor will shrink away and leave an ugly crack at this point unless allowance is made for this movement.

The proper way to prevent these cracks is to either nail a ¼-round moulding to floor at the bottom of base-board or use a two-member base moulding in which the upper member is tongued into the lower one, the upper member being fastened to wall and the lower one to floor.

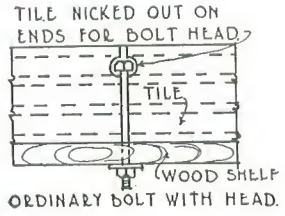


Fig. 956-A

Fig. 956-B

Elevation and plans for supporting shelves to hollow tile walls by means of headless anchors or ordinary machine bolts.

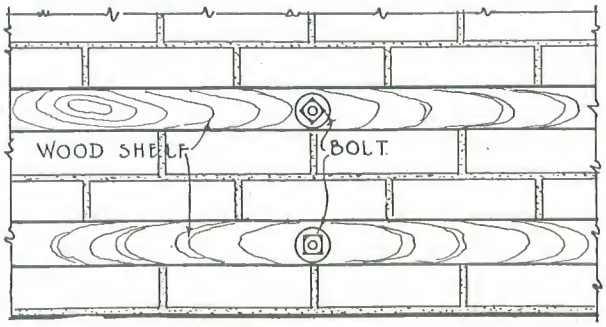
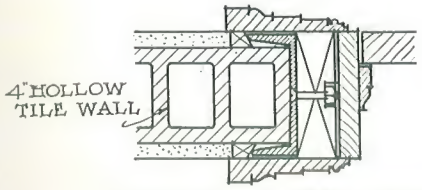
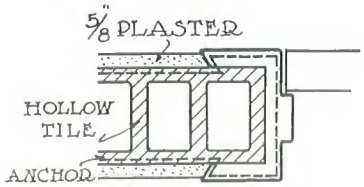


Fig. 956

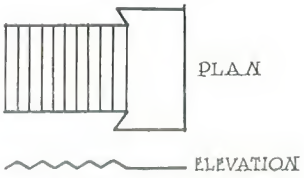
FRAMING PARTITION OPENINGS



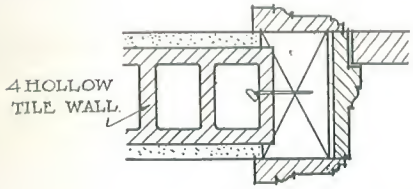
COMBINATION STEEL CHANNEL AND WOOD BUCK. WOOD TRIM & FRAME



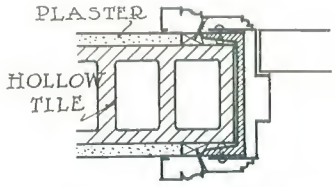
DETAIL OF SHEET STEEL DOOR FRAMES



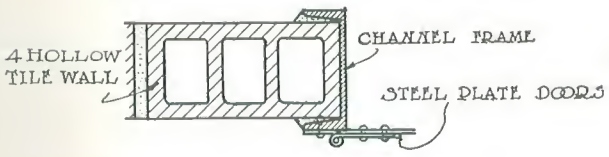
ANCHORS IN THE JOINT



RABBITED WOOD BUCK WOOD TRIM AND FRAME

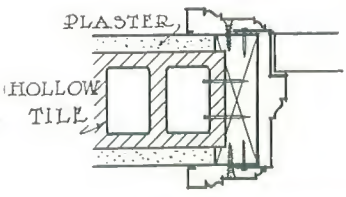


STEEL DOOR FRAMES WITH STEEL TRIM AND ROLLED STEEL BUCKS

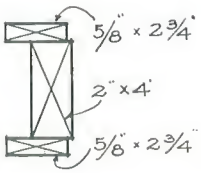


STORAGE WAREHOUSE PARTITION

Fig. 986
Typical detail of storage warehouse partitions with steel channel or wood buck frames, with and without wood trim.



STEEL DOOR FRAMES WITH WOOD BUCKS AND STEEL TRIM



ALTERNATE WOOD BUCK

Fig. 987
Typical details of steel door frames with wood or steel bucks and metal trim.

ISOLATED PIERS

Isolated or free standing piers are of two kinds: load bearing piers or columns, such as are built in a cellar for the support of first floor griders; and exterior piers, which may be either load bearing for the support of a second story overhang, or ordinary porch piers which support only the cornice or roof of the porch. All such piers may be built of Hollow Tile. Details for cellar piers are shown on page 39 and details for porch piers by Fig. 994-B, page 40.

In a house built of Hollow Tile it is generally advisable to have the porches, as far as practicable, built of Hollow Tile. Where the porch walls form an arcade the entire porch construction should be of Hollow Tile but where the roof is of wood carried on fairly wide spans between piers, it is seldom advisable to build the lintel or beam of Tile as these can best be built of wood. This form of porch construction is shown on page 40. When the arches are supported on Hollow Tile piers, the arch should be a true semi-circular arch. Flat segmental or three centered arches are seldom advisable unless ample abutment is provided. Where such arches are required for architectural effect, it is best to construct them as a reinforced lintel, so as to tie the piers together. See Fig. 994-B on page 40 for details of typical pier and lintel construction for porches.

Exterior Hollow Tile piers should never be less than 12″x12″ in plan, except the wider piers may be 8″ in thickness and of the shape shown by Fig. 994-B on page 40. Railing or wall between such piers may also be of tile of any desired thickness.

PILASTERS

Pilasters or engaged piers may be built of Hollow Tile, integral with the wall proper.

Pilasters on stuccoed Hollow Tile walls will generally look the best if of a slight projection, not exceeding 2″. This projection, however, may be of any depth desired, in steps of 1″ from 2″ to 6″ and then in steps of 2″ up to 12″.

The use of pilasters on factory building walls frequently permits the main wall to be of less thickness than a straight wall.

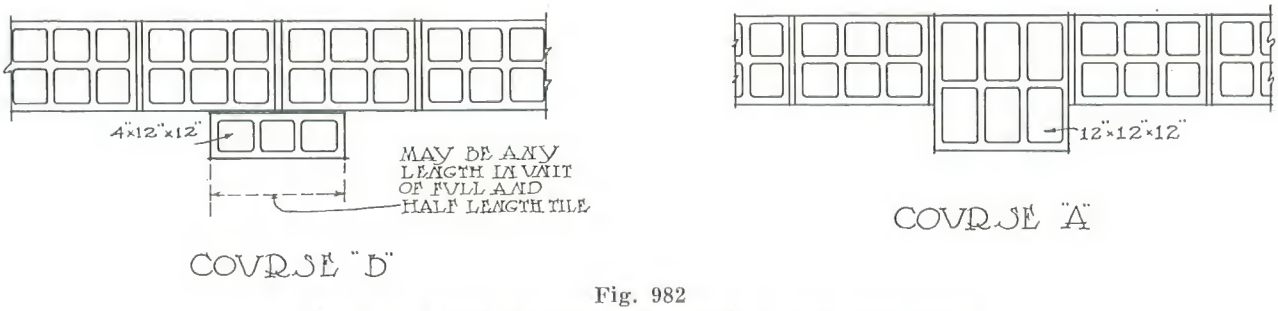


Fig. 982
Method of bonding pilasters into walls in end construction.

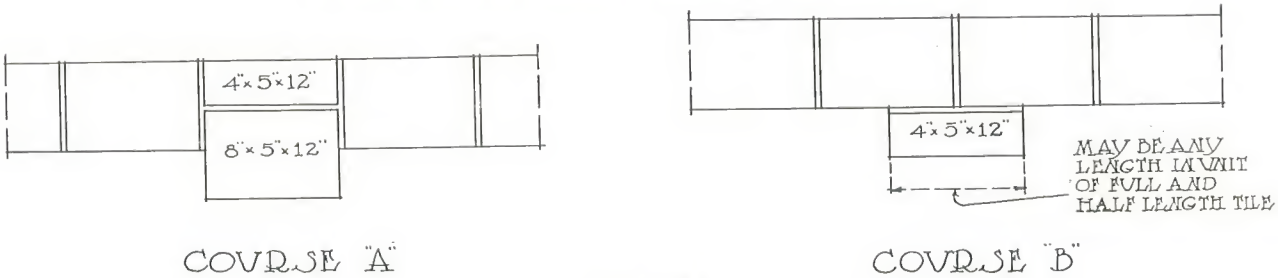


Fig. 983
Method of bonding pilasters into walls using side construction. Care must be exercised to completely fill the exposed air cells in the pilaster projection beyond the face of the wall

BELT COURSES ON WALLS

Belt courses are frequently desired for architectural effect and to break up an otherwise wide expanse of plain stuccoed wall. Belt courses can very readily be formed of concrete on Hollow Tile walls and stuccoed like the balance of the wall. They may also be built of brick, stone or concrete when the wall is trimmed with these materials.

Belt courses of any solid material should not extend entirely through the wall.

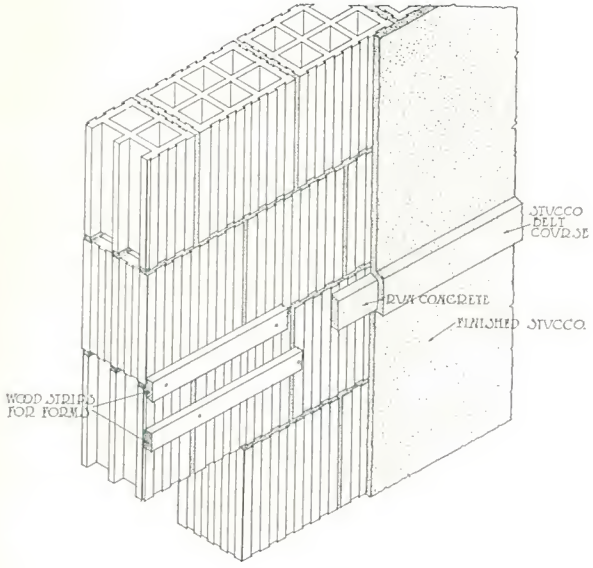


Fig. 995
Correct method of building belt course in end construction.

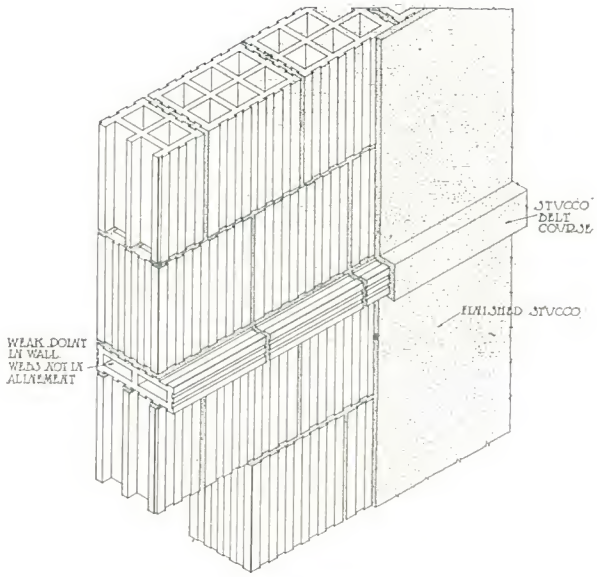


Fig. 996
Wrong method of building belt course in end construction.

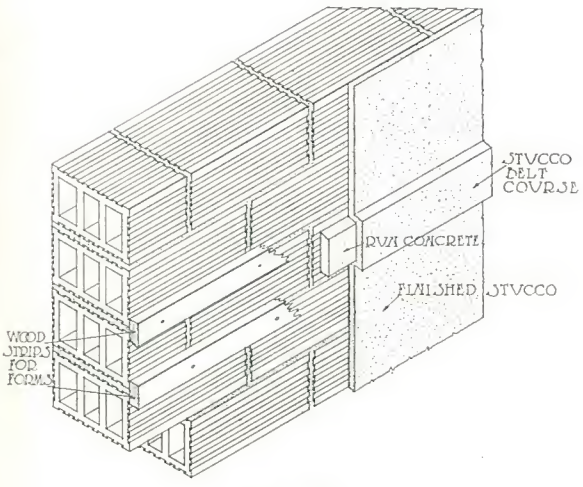


Fig. 997
Correct method of building belt course in side construction.

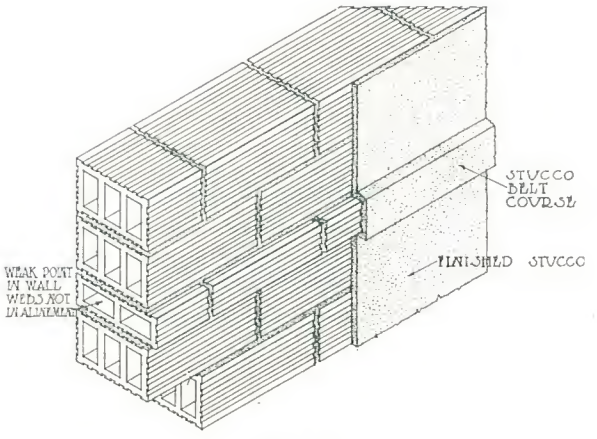


Fig. 998
Wrong method of building belt course in side construction.

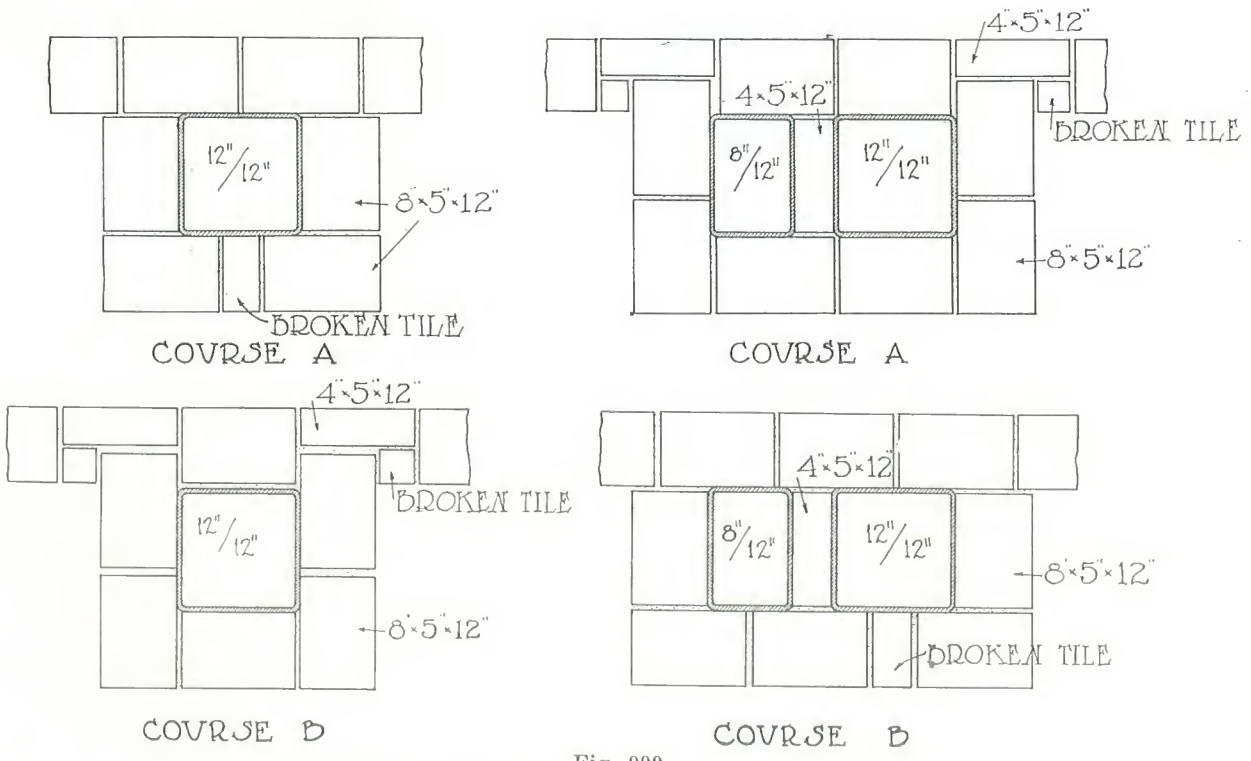


Fig. 999
Detail of bonding wall in side construction for single and double flues.
Care must be exercised to completely fill all the exposed air cells at all corners.

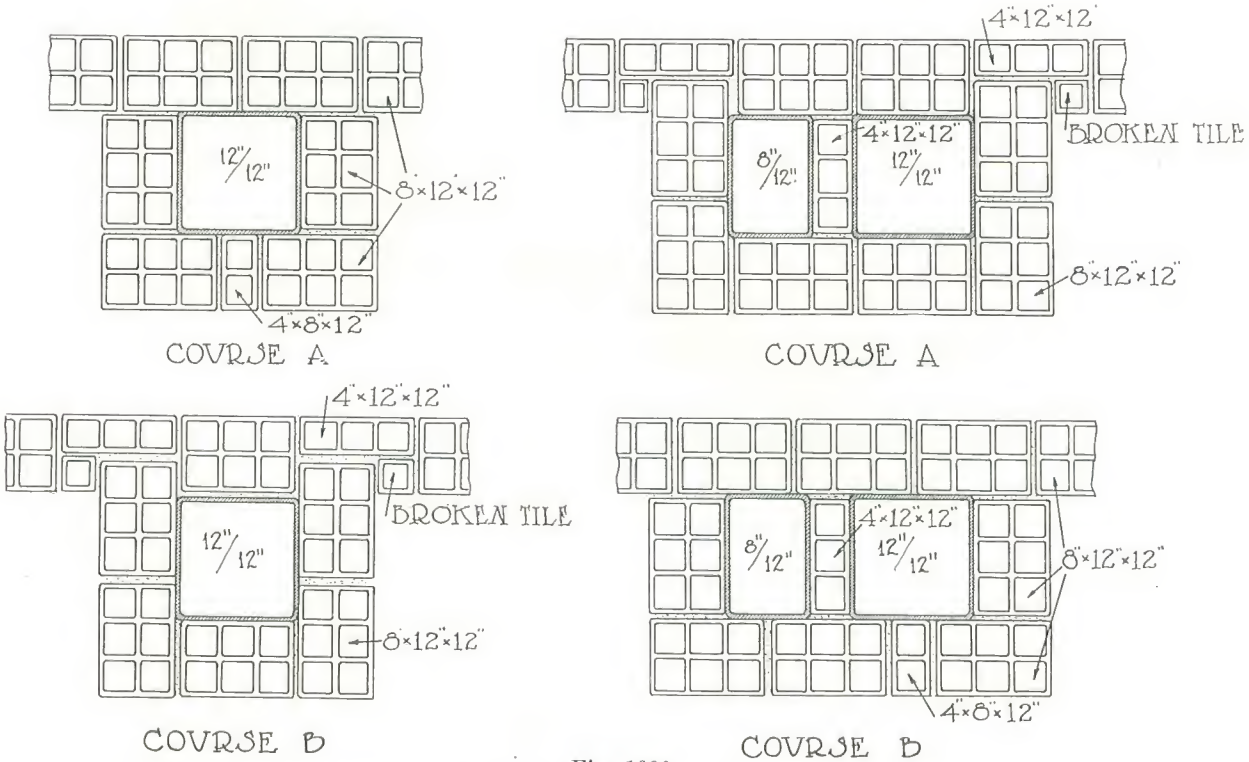
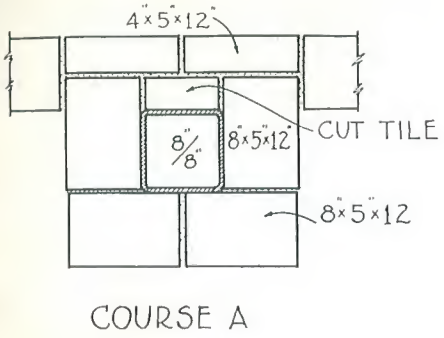
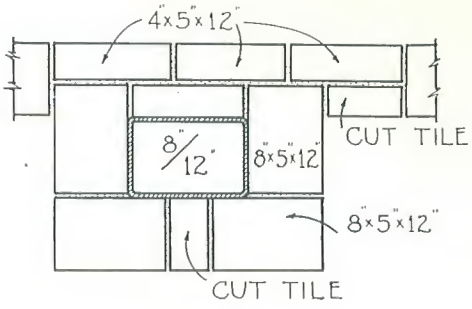


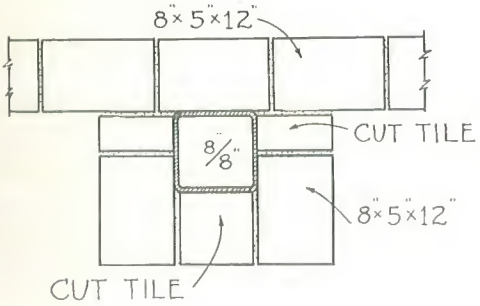
Fig. 1000
Detail of bonding wall in end construction for single and double flues.



COURSE A

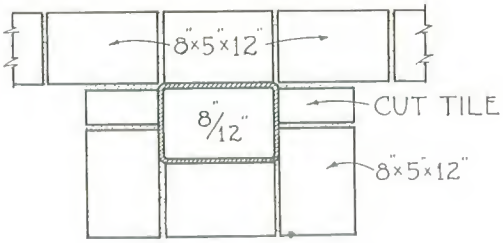


COURSE A



COURSE B

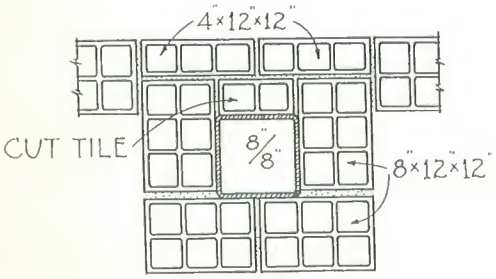
Fig. 1111



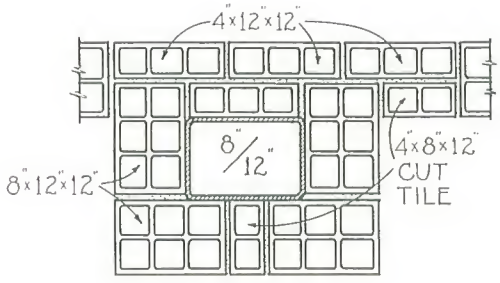
COURSE B

Fig. 1112

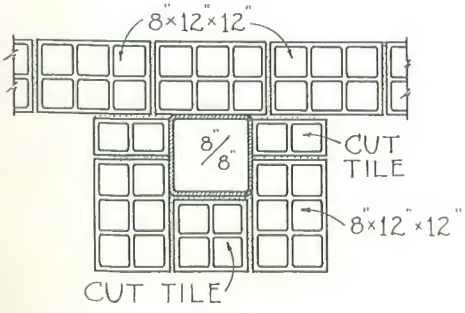
Bonding details for side construction.
Care must be exercised to completely fill all the exposed air cells at all corners.



COURSE A

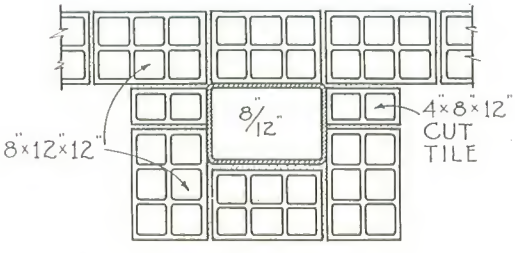


COURSE A



COURSE B

Fig. 1111-A



COURSE B

Fig. 1112-A

Bonding details for end construction.

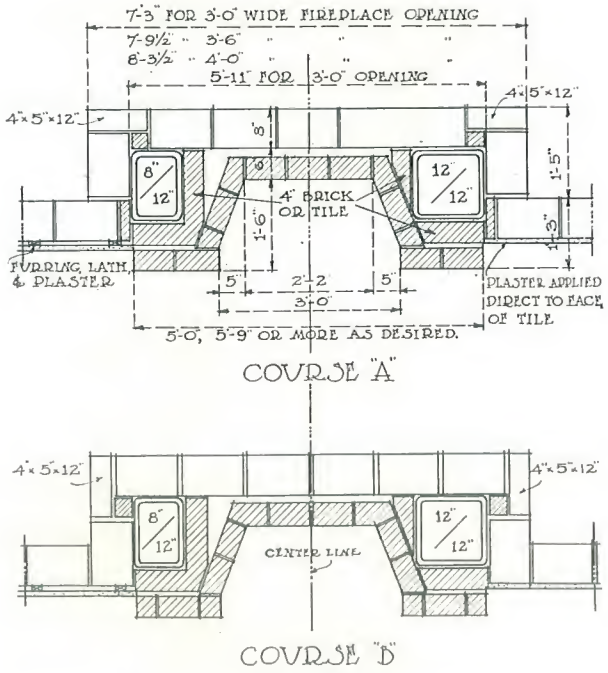


Fig. 973

Fireplace with side flues from furnace and for laundry stoves set flush on inside in wall of 8 x 5 x 12 tile, side construction.

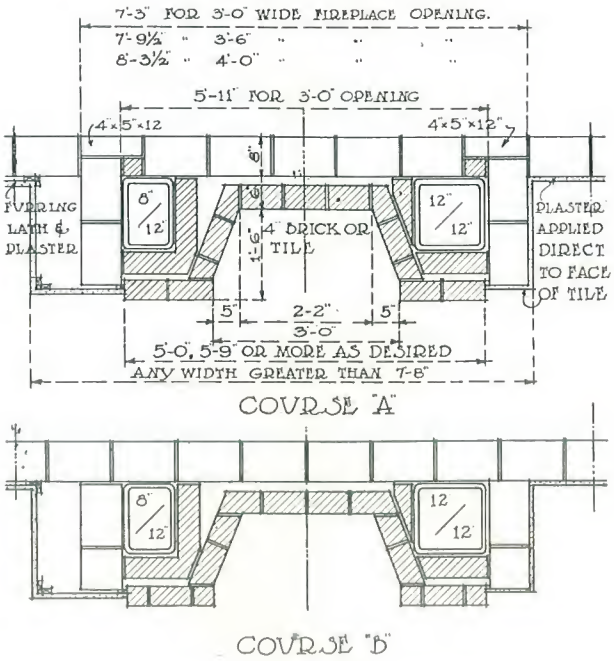


Fig. 971

Fireplace with side flues for furnace and for laundry and kitchen stoves set flush on outside in walls of 8 x 5 x 12 tile, side construction.

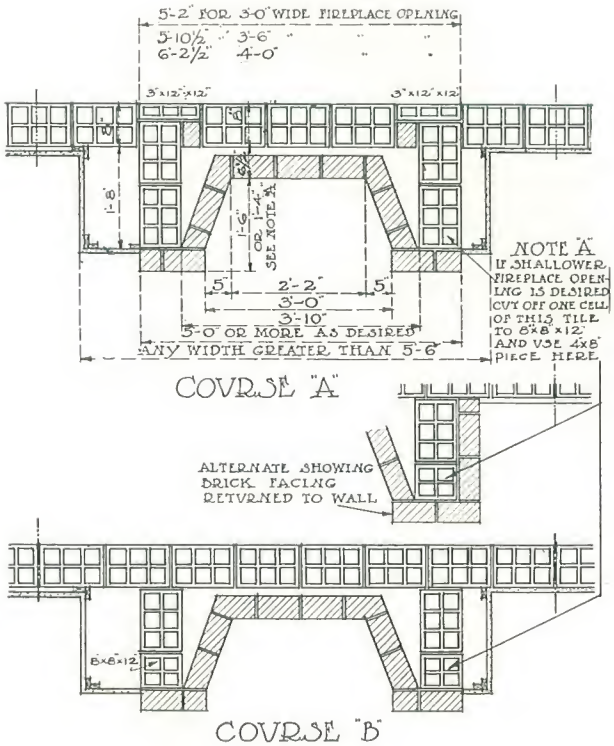


Fig. 969

Fireplace without side flues set flush on outside in walls of 8 x 12 x 12 tile, end construction.

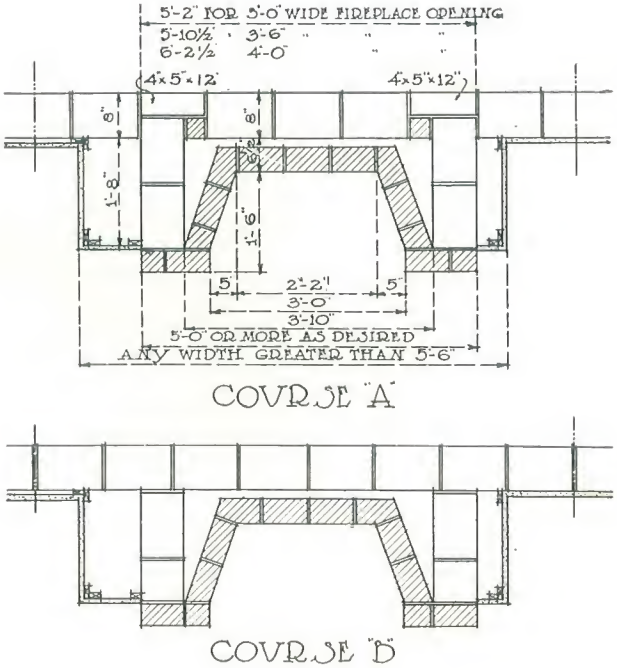


Fig. 1012

Fireplace without side flues set flush on outside in walls of 8 x 5 x 12 tile, side construction.

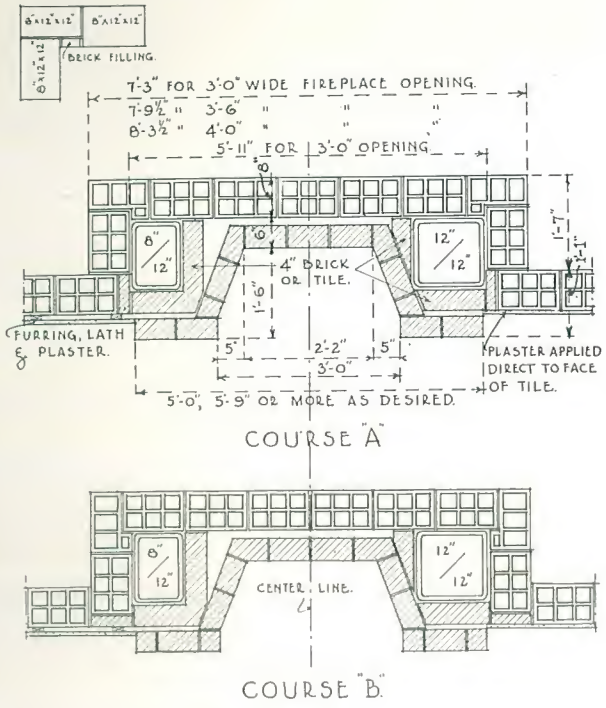


Fig. 974

Fireplace with side flues from furnace and for laundry stoves set flush on inside in walls of 8 x 12 x 12 tile, end construction.

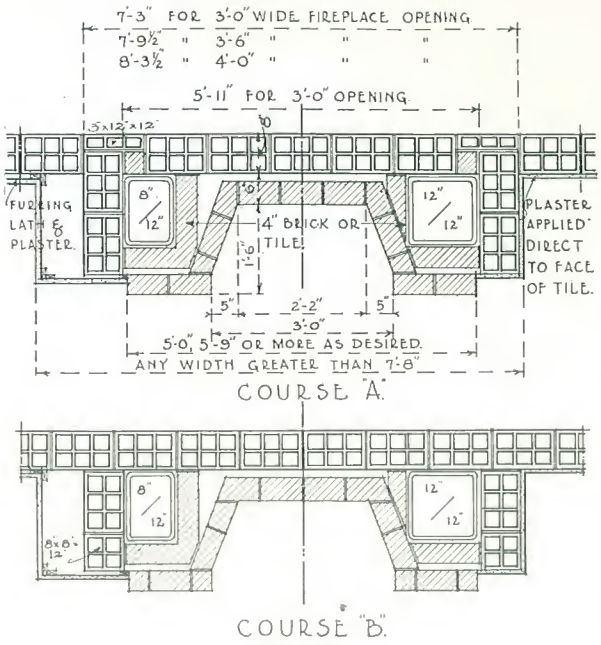


Fig. 972

Fireplace with side flues from furnace and for laundry and kitchen stoves set flush on outside in walls of 8 x 12 x 12 tile, end construction.

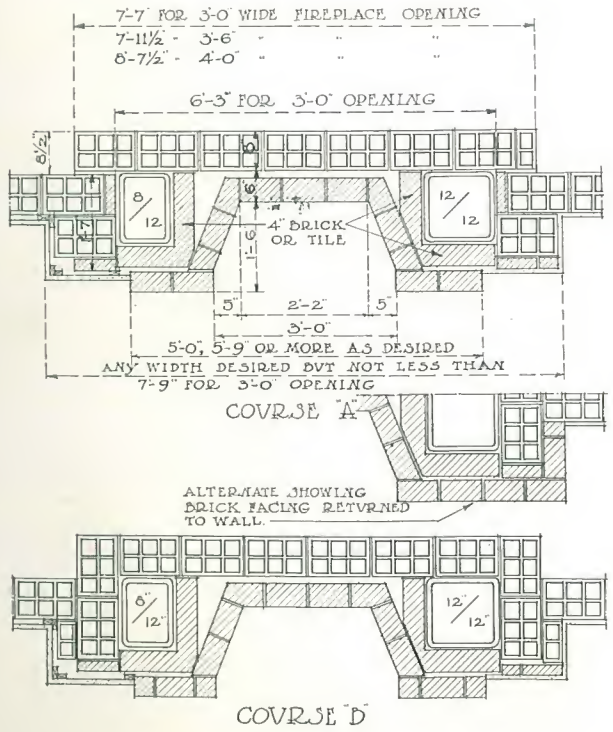


Fig. 976

Fireplace with side flues from furnace and for laundry and kitchen stoves set midway in wall of 8 x 12 x 12 tile, end construction.

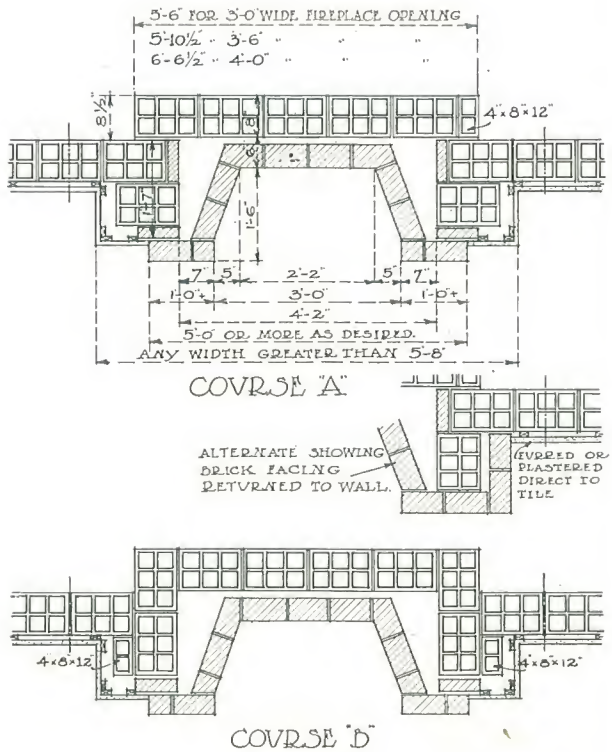


Fig. 970

Fireplace without side flue set midway in walls of 8 x 12 x 12 tile, end construction.

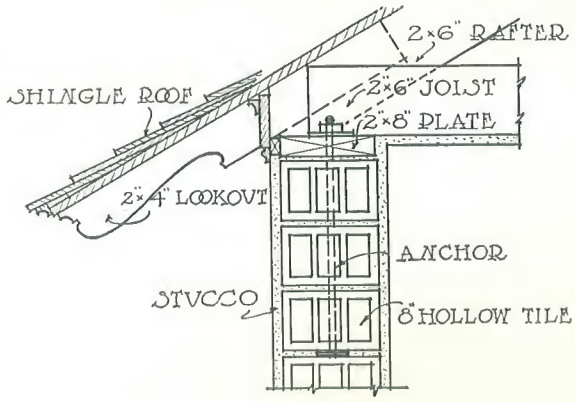


Fig. 961
Typical side construction at eave.

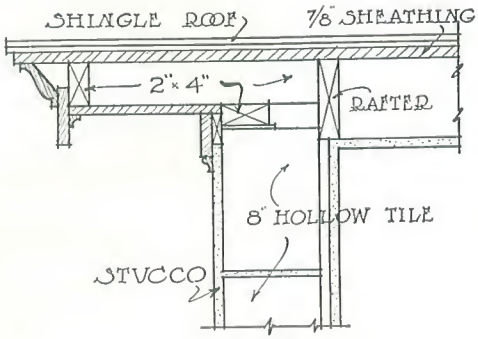


Fig. 961-A
Typical end construction at gable.

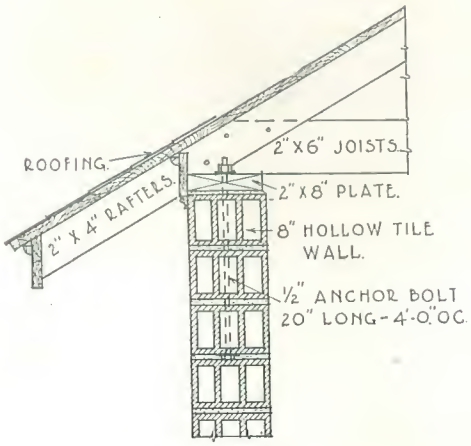


Fig. 883
Roof detail and eave construction in connection with exposed side construction hollow tile.

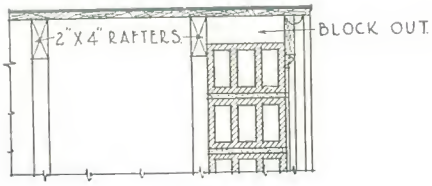


Fig. 883-A
Section through gable.

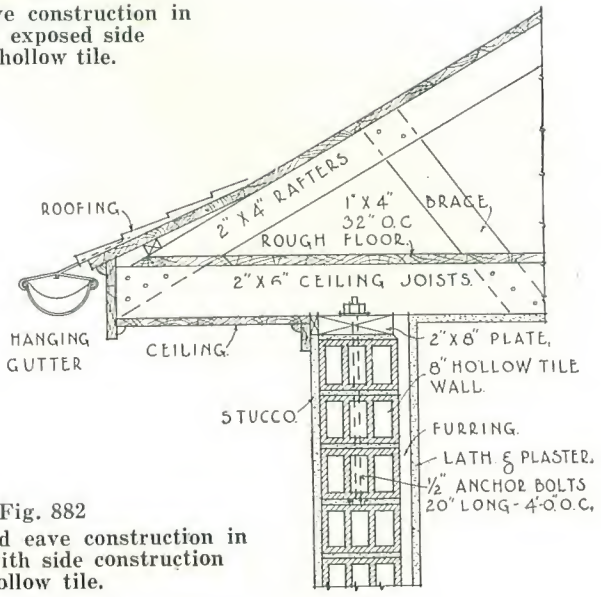


Fig. 882
Roof detail and eave construction in connection with side construction hollow tile.

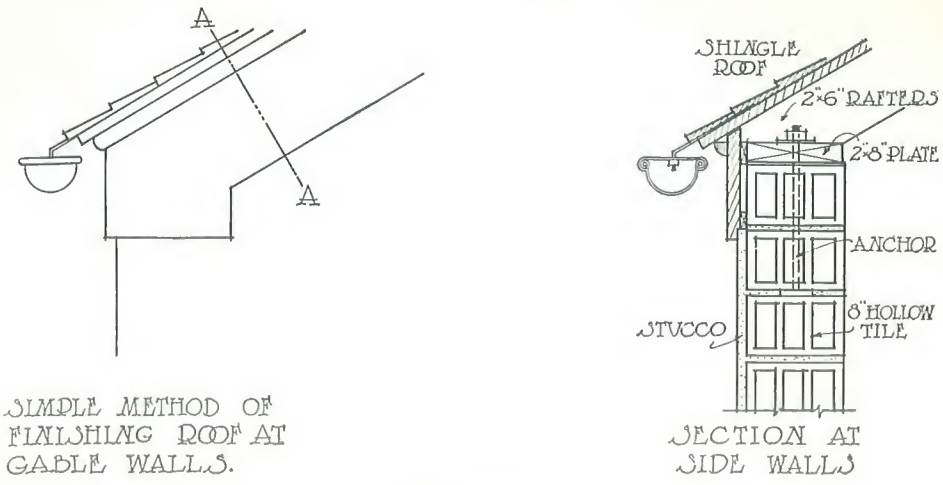


Fig. 962-A
Typical side construction with flush eave.

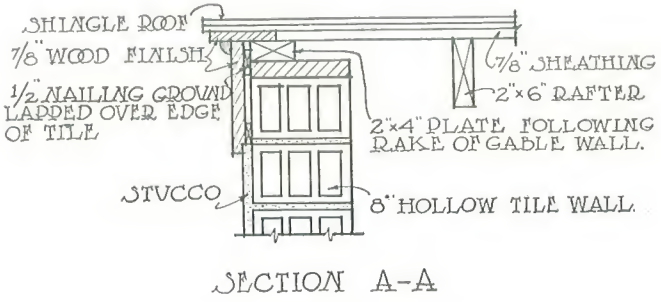


Fig. 962
Typical side construction with flush gable.

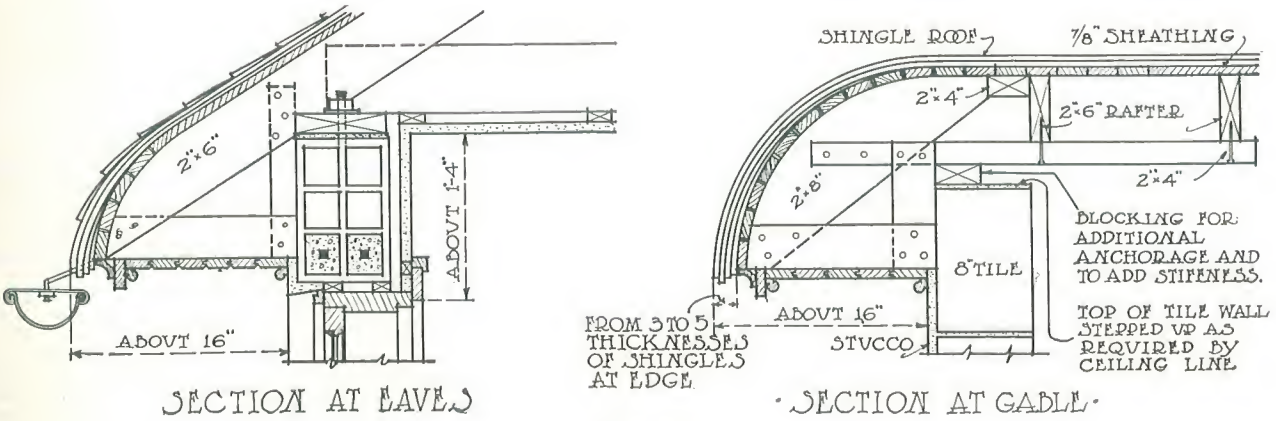


Fig. 964
Shingle thatched roof effect on hollow tile building.

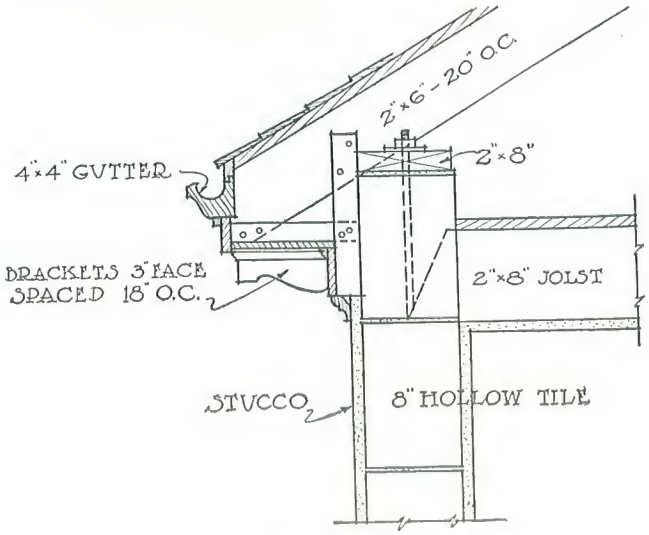


Fig. 963
Typical end construction with Colonial eave.

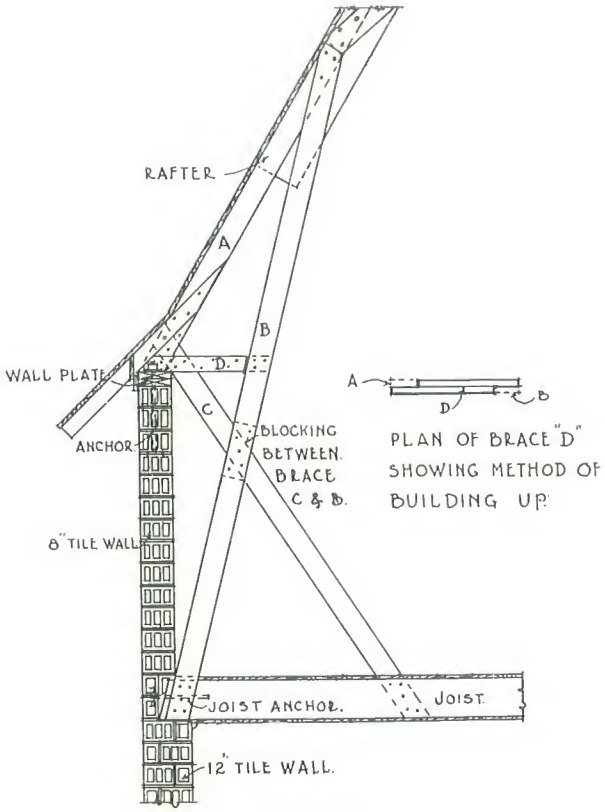


Fig. 916
A practical method of tying rafters and floor joist together. These braces will relieve the upper portion of walls against outward thrust from the roof.

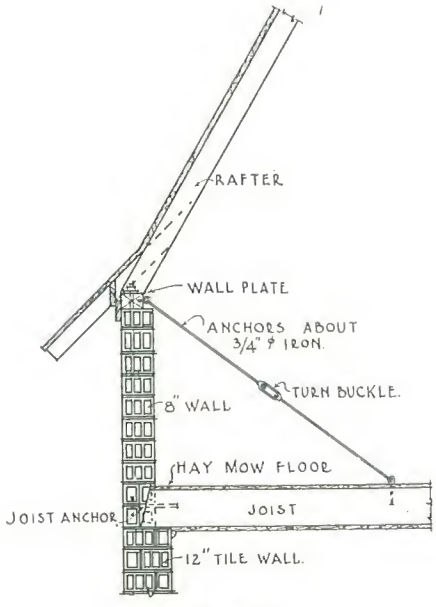


Fig. 918
This illustration shows the same object being accomplished by using an iron rod and turning buckle in place of the timber frame.

EXPOSED TILE WALLS

Smooth Face Tile:

Smooth face tile as applied to hollow building tile is a relative term. It refers to a more or less rough structural tile from which the grooving or scoring for plastering key has been omitted and has a plain surface of a texture similar to the face of a common brick. It therefore does not imply a perfectly smooth or mechanically perfect surface, or a surface that is glazed smooth or otherwise finished. Smooth faced tile are furnished for use in buildings that are not to have any other exterior finish.

This product furthermore is not selected for color and, unless specially ordered otherwise at some advance in cost, is generally supplied in kiln run range of color. Only the actually imperfect tile, overburned and underburned pieces, being culled and all properly burned structurally sound tile, regardless of color being shipped.

In the product of some manufacturers this may mean a fairly uniform color, while in the product of others, a range from medium buff to dark brown; from light to very dark red, or from a light reddish brown to a chocolate brown.

Smooth face tile find their largest field of usefulness in the construction of farm buildings, small garages and other low cost moderate size buildings and for the enclosing walls of factories, warehouses and other commercial structures. A wall of smooth faced building tile that has been selected for a reasonable uniformity of color, or one built of very wide variation, if the latter is intelligently used by a careful distribution of the various colors throughout the work to obtain a mottled and not a patchy effect, will have a very pleasing effect, if a little consideration is given to the jointing and the general arrangement, size and placing of openings. This material will naturally not be used for buildings of architectural pretensions, but of itself can be made to look very well and there is no reason why the simple building should not have an inherent and home-like beauty from its proportions, its logical construction and suitability to purpose and the avoidance of ill-considered or ugly appurtenances and accessory detail.

The wall of tile is permanent; it therefore merits properly built window and door frames, a little better type of door than might be considered suitable for a temporary frame structure and a little finish to the coping, cornice or overhanging roof that may serve as the "topping-off" feature.

Texture Faced Tile:

Texture face tile are made in limited quantities by a few manufacturers to supply a demand created for a surfaced material to be used in more pretentious buildings. The rough texture face is made in variegated shades from buff to the deeper reds. These tile require no further exterior finish.

THE FINISH OF HOLLOW TILE WALLS

Brick Veneer:

Hollow Building Tile is the ideal backing for a veneering of brick. Pages 20 and 21 show various brick bonds and the manner in which these are bonded to the Hollow Tile backing.

To be a satisfactory backing for brick work, provision must be made for the proper bonding of the two materials in order that the full thickness of both may be figured for all purposes and requirements of most city building codes. This requires that the backing will course in with the facing at certain intervals. All other requirements are about the same as for stucco finishes.

Most forms of wall tile are specially designed in sizes and shapes that will permit the bonding of brick header courses, and for those forms of end construction tile in which the regular shapes do not course in, the tile may be ordered cut to any length required at slight additional expense.

Hollow Tile construction is entirely free from the shrinkage cracks which occur in brick veneered frame wall construction.

Cement Stucco:

Most people appreciate the artistic value of stucco and how appropriate it is as a background for shrubbery and foliage of all sorts,

but do not appreciate its structural value and permanent qualities because they have seen so much of it cracking and falling off of frame buildings, and from masonry walls that do not afford a permanent or proper bond.

Stucco cannot crack or come off of a Hollow Tile wall once it has been properly applied. There is a genuine bond between these materials and any attempt to separate them will demonstrate this, as the line of cleavage will not fail in the joint between the two materials.

Hollow building tile as a backing for stucco is ideal; it does not shrink or swell, has a low absorption value, contains no soluble salts, will not disintegrate, and has a surface that is both sufficiently rough and dense to insure the best bond between the two materials, and it further is scored with dovetail grooves that provide the strongest mechanical bond.

In order to be assured of a permanent stucco finish the backing must have the following characteristics, all of which are amply provided for in a wall constructed of Hollow Tile:

1. It must not expand or shrink. Stucco is practically inexpansive, being only slightly affected by heat and not at all by moisture.

2. It must not disintegrate under the stucco, and must not corrode or rust.

3. It must have a low absorption value. If cement stucco is applied to a highly absorptive surface like soft brick or concrete, this surface extracts the water and soluble part of the mortar, preventing a proper set and leaving a thin layer of porous sand and cement next to the backing surface, where the bond between the two materials should occur. This is the chief reason why stucco is not permanent upon a soft or porous surface.

The surface should therefore be hard and have an absorption of not over 12 per cent, and in order that the stucco may be held in place during the time of setting, and to further secure a mechanical bond, the surface of the backing should be well roughened or grooved.

4. Moisture must not be allowed to accumulate in back of the stucco; this also demands a low absorption of the backing.

5. Backing must not contain soluble salts, which may eventually permeate the stucco and appear as blotches disfiguring the exterior surface. Precaution must also be taken that the sand used both in the mortar for laying of wall and in the stucco does not contain soluable salts. Sea sand should never be used.

Lime mortar should never be used in a wall to be stuccoed with a magnesite composition, though a small proportion of thoroughly hydrated lime may be added to the cement mortar, in order to make it both more plastic and more dense when the tile wall is to be covered with a portland cement stucco.

A good rich mortar mixture should always be used to lay up the wall that is to be stuccoed. When a porous mortar is used there will be a tendency for the mortar joints to absorb too much water from the stucco, and this may result in the surface opposite these joints drying out more rapidly and showing a slightly different color. If stucco coating is quite thin this will be particularly noticeable, making the joints between the tile visible in checkerboard fashion. This trouble is also very liable to occur if lime mortar is used for setting the tile, but will never occur where the right kind of tile and mortar are used.

Hollow Tile laid in a good Portland cement mortar may be depended on to give you the proper base for a beautiful and everlasting stucco finished wall. Standard load bearing tile that are made to be set on end have the deep dovetail scoring, while the various shapes that are made to be laid on the side have a lighter dovetail grooving, as the horizontal grooving does not need to be so deep in order to hold the wet stucco mortar in place against the natural tendency to slide down or sink away from the position in which it is applied to the wall.

Magnesite Stucco Composition:

Hollow Tile provides a most excellent base or backing for all Magnesite stuccos; the qualities that make it the ideal base for Portland Cement stucco are of equal advantage where Magnesite stucco finishes are to be used. There is one item of importance to remember, however. Lime must not be used in the mortar for any wall that is to be stuccoed with a Magnesite composition, as the chemical reaction between Magnesite and lime is very uncertain, and even the usual 10% or 15% of lime may cause trouble and should be omitted.

Manufacturers' directions should be strictly followed in the application of these finishes.

Interior Finish for Hollow Tile:

In factories and other similar buildings the walls are frequently left unplastered and the tile given a coat of whitewash or cold water paint, for which purpose a smooth-faced tile should be used. Special enamel paints have also been developed for application directly on the face of the tile. These give a beautiful hard washable surface that is most suitable for this class of structure; such surfaces are free from glare, although they reflect the light admirably and assist in the lighting of the building.

The American Concrete Institute, in placing Hollow Building Tile at the head of the list of structural materials best suited as a base for cement stucco, in a recent report says:

"Tile for exterior walls, columns, etc., should be hard burned, with dovetail ragged scoring. Tile should be set in cement mortar composed of one part cement, not more than one-fifth part hydrated lime and three parts sand, by volume. The blocks should vary not more than ½ in. in total thickness and should be set with exterior faces in line. Joints should not be raked, but mortar should be cut back to surface. Neither wire wesh nor waterproofing of any type should be applied to tile walls before plastering. The surface of the tile should be brushed free from all dirt, dust and loose particles, and should be wetted to such a degree that water will not be rapidly absorbed from the plaster, but not to such a degree that water will remain standing on the surface when the plaster is applied."

CEMENT STUCCO

Mortar for exterior cement stucco or cement plastering should first be mixed dry. Spread the sand in a layer about 4 inches thick and dump the quantity of cement required on top of the sand and thoroughly mix the two materials dry until a uniform color is obtained; then add two-thirds of the quantity of water required and again mix, adding water as required to any dry spots, to obtain a uniform mass of proper consistency. A slight excess quantity of water is better than too little; but too much will make the mortar thin and more difficult to handle and retard the setting somewhat, especially in damp or cold weather.

When dry hydrated lime is used in cement mortar it should be added with the cement and mixed in dry before water is added.

Before applying cement stucco the HollowTile walls should be thoroughly cleaned from dust, dirt and lime mortar, and thoroughly moistened with water. When using magnesite stucco, moisten the walls with the mixing solution.

Cement plastering should be kept moist and protected from the sun, wind and frost until it has thoroughly hardened. If the surface is worked too much with a "float" or trowel, bringing a lot of cement to the surface, it is apt to develop hair cracks or shrinkage cracks. To prevent this it is better to finish the surface with a felt polisher, if a reasonably smooth surface is desired, or with a wood, cork or carpet covered float for all ordinary purposes.

Hair cracks are due to a shrinkage of the surface, as they do not extend into the mortar. They are more apt to occur in a wet mortar than in a dry one. They are also more noticeable on a smooth surface than on a rough one. As their depth is no thicker than a coarse hair, they can be removed very easily and the surface at the same time be given a very good appearance by acid wash.

Make a mixture of one part commercial muriatic acid and five parts water. Apply this to the surface with a stiff corn broom about three or four times, one application immediately after the other. Let this remain from five to ten minutes and then thoroughly scrub with clean water. If, after this treatment, the cracks still appear, repeat the operation, being careful to wash it off thoroughly, at the same time scrubbing it.

MATERIALS FOR 100 SQUARE FEET OF CEMENT MORTAR FOR STUCCO

Thickness in Inches	1:1½		1:2		1:3	
	Cement Bbls.	Sand Cu. yds.	Cement Bbls.	Sand Cu. yds.	Cement Bbls.	Sand Cu. yds.
½	.60	.14	.50	.15	.37	.17
¾	.90	.20	.74	.22	.55	.25
1	1.20	.27	1.00	.29	.74	.33
1½	1.79	.40	1.48	.44	1.10	.49

CEMENT MORTAR

Hollow Building Tile should be set with cement mortar composed by measure of one part Portland cement to not more than three parts clean sharp sand, to which may be added hydrated lime not exceeding 15% by volume of the cement.

Note—The percentage of lime added is always figured on the quantity of the cement used, therefore 15 per cent is equal to about one-sixth part by measure of the cement.

The lime specified is not needed to make the mortar stronger, but to make it more plastic and easier to handle. Mortar containing lime will adhere better to the tile, makes a neater job and results in a saving in labor. Too much lime must not be used as it weakens the mortar. A straight lime mortar, however rich the mixture, is not suitable for setting Hollow Tile.

A sand containing a quantity of loam must not be used for cement plastering or stucco.

Sand containing a little clay may be used if the grains are not coated.

Table gives quantities of mortar materials required to lay up 1,000 pieces of Hollow Tile (pieces not square feet) of the various sizes given. This table allows about 10 per cent for waste and is based on the mixture that is recommended for Hollow Tile construction, consisting of one part Portland cement and three parts sand, to which 15 per cent of hydrated lime or lime putty is added.

For the convenience of builders the table gives the quantities of lime both by measure and weight for lump lime and by weight for hydrated lime.

TABLE OF QUANTITIES FOR CEMENT MORTAR

Materials Required to Lay Up 1,000 Pieces of Hollow Tile

Barrel of Cement Specified to be 3.8 cu. ft.

Size of Tile	Thickness of Wall	Approximate Quantity of Mortar, Cu. Ft.	Mortar Materials Required				15% These Quantities For Ordering Lump Lime in Lbs.
			Cement Sacks	Sand, Cu. Ft.	15% Dry Hydrated Lime, Lbs.	15% Lump Lime Paste, Cu. Ft.	
4x5x12	4″	19.66	6.28	19.65	38	.94	28
5x4x12	5″	23.12	7.36	23.11	44	1.10	33
5x8x12	5″	28.91	9.24	28.89	55	1.38	42
8x5x12	8″	39.33	12.56	39.31	75	1.88	56
4x5x12 } 8x5x12 }	12″	59.02	18.88	59.02	113	2.83	85
4x12x12	4″	27.75	8.92	27.72	54	1.34	40
6x12x12	6″	41.66	13.32	41.66	80	1.99	60
8x12x12	8″	55.54	17.76	55.53	107	2.66	80
12x12x12	12″	83.33	26.64	83.32	160	3.99	120
					"A"	"B"	"C"

Use either one of Columns "A" and "B".

Column "A" is for dry hydrated lime purchased in bags.

Column "B" is for lump lime purchased by barrel or ton.

Column "C" gives the approximate quantity of lump required to make the amount of lime paste given in Column "B".

A barrel of lump lime containing approximately 3 cubic feet, weighing 185 pounds net will produce about 6. to 6.5 cubic feet lime paste which, on account of water added will weigh about 70 pounds per cubic foot.

Note—In giving size of tile, the first number always indicates the thickness of wall, the second the width of tile and the third, the length to which it is cut.

A cubic foot of hydrated lime weighs 40 lbs.

A cubic foot of cement weights 100 lbs.

Therefore at 15% there will be 6 lbs. of hydrated lime to add to each cubic foot of cement.

TWO COAT STUCCO WORK

The first coat should thoroughly cover the Hollow Tile on which it is applied and be well troweled to insure proper mechanical bond with the dove-tail scoring of the Hollow Tile blocks. Before the coat has set it should be cross-scratched with a saw-toothed paddle to provide a strong mechanical key for the finish coat. The plastering should be carried on in a continuous direction without allowing the plaster to dry at the edges.

This first coat should be brought to a true and even surface by the use of a straight edge. When this coat has stiffened sufficiently, it should be dry floated with a wood float.

The second or finish coat should be applied not less than a week after the first coat. The finish coat serves only as a decorative feature, having no structural value. Any mixture or method of application that may in any way injure its permanency, should be avoided.

HOLLOW TILE WALLS WITH LIMESTONE ASHLAR VENEER

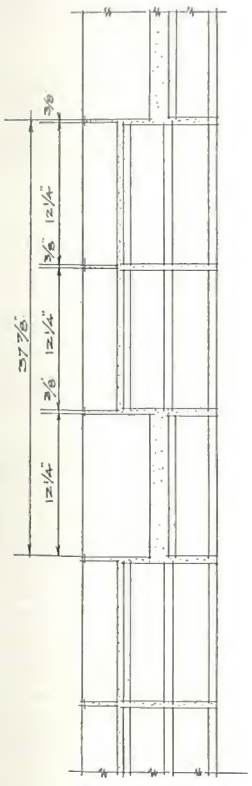


Fig. 1048

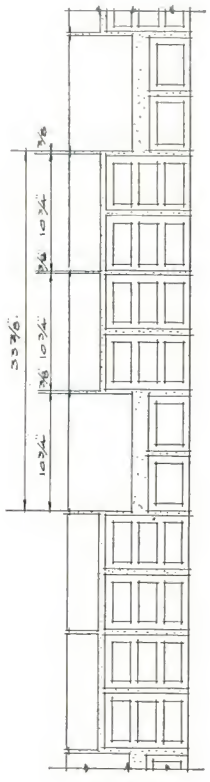


Fig. 1049

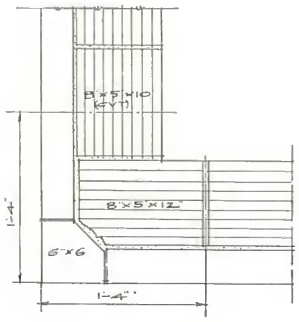


Fig. 1050

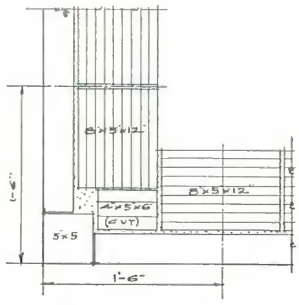


Fig. 1050-A

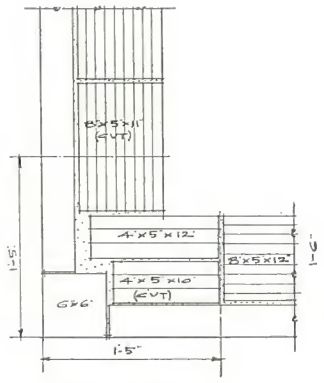


Fig. 1050-B

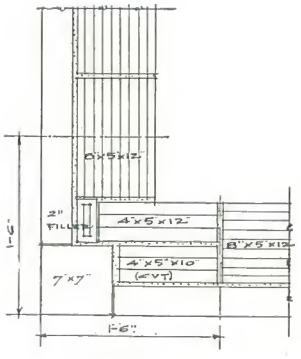


Fig. 1050-C

These details show various methods of bonding h llow tile, both end and side construction with Limestone veneer or facing.

METHOD OF ESTIMATING QUANTITIES OF TILE REQUIRED

Take the length of each outside wall in feet and multiply by the height in feet, which will give the superficial area in square feet, and then deduct for all window and door openings which are over 4 square feet in size. This will give the net area of each wall, which, added together, will give the total net area of wall surface.

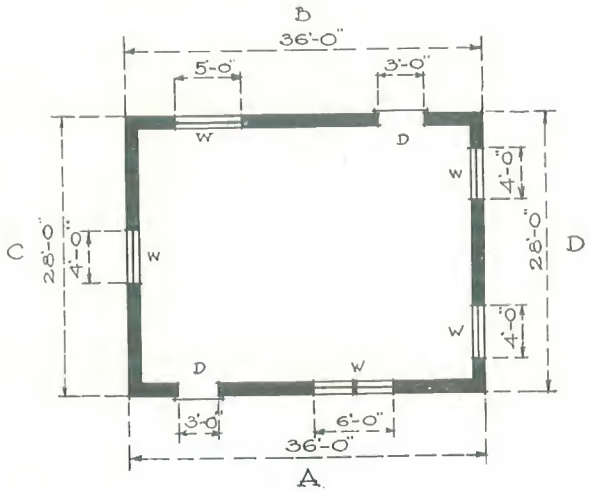


Fig. 981-A

In the illustration shown above, A and B are the same length and C and D are the same length, so we get:

		Sq. Ft.
Walls A and B	2x36′-0″x14′-0″	1,008
Walls C and D	2x28′-0″x14′-0″	784
Gables C and D	2x28′-0″x 5′-0″	280
Total		2,072

Deductions for windows and doors:

		Sq. Ft.	
2 doors	3′-0″x7′-0″	42	
1 window	6′-0″x5′-0″	30	
1 window	5′-0″x5′-0″	25	
3 windows	4′-0″x5′-0″	60	
2 gable windows	3′-0″x3′-0″	18	
		175	175
Total net area in sq. ft.			1,897

Now, 1,897 square feet equals the total net area or superficial feet of all walls.

In order to convert this into the number of tile required, we first determine the thickness of the wall and the size of tile required.

Assuming an 8x5x12 tile was to be used in an 8″ wall side construction, we would multiply 1,897 by 2.4, which equals 4,552.

Fig. 981

Also, if a 12x12x12 tile was to be used in a wall 12″ thick end construction, we would multiply 1,897 by 1, which equals 1,897, the number of tile required for tile courses 12″ high.

Table Showing Required Number of Tile in a Square Foot of Wall Area, Allowing for Ample Overage:

NOTE: For special types referred to on page 9, see special literature of the individual manufacturers.

Sizes of Tile.		WALL					
		3 in.	4 in.	5 in.	6 in.	8 in.	10 in.	12 in.
4x 5x12	Side const...	....	2.4	3.0	....	....	....	{ 2.4 }
8x 5x12	Side const...	....	....	1.5	....	2.4	....	{ 2.4 }
3x12x12	End const...	1.0	....	....	....	....	....	4.0
4x12x12	End const...	....	1.0	....	....	....	....	3.0
6x12x12	End const...	....	....	....	1.0	....	....	2.0
8x12x12	End const...	....	....	....	....	1.0	....	1.5
10x12x12	End const...	....	....	....	....	....	1.0	1.2
12x12x12	End const...	....	....	....	....	....	....	1.0

NOTE: A 12″ wall side construction may be built up by bonding 4x5x12 and 8x5x12 tile together.

The quantity of corners, joist course, sill, lintel and jamb or closure tile should be figured separately and deducted from the straight wall area.

If the tile units are to be laid on the side, closures and half-closures will be necessary at the jambs of all straight openings unless these are to be closed by filling the ends of the tile with concrete. Where recessed box window frames are used, jamb tile and half-jamb tile will be required.

Some form of tile will be required for bonding the corners in any event, and also some form

for providing a bearing surface for joists and some form of tile for lintels will be required unless the regular straight wall tile is used by filling with concrete and reinforcing them for lintels.

Lintels:

In determining the quantity of lintels required for window and door openings, we add together the length of each window and door opening, allowing at least 6″ bearing on each side of these window and door openings for the lintel to rest upon.

2 doors	3′-0″ long	8′-0″
1 window	6′-0″ long	7′-0″
1 window	5′-0″ long	6′-0″
3 windows	4′-0″ long	15′-0″
2 windows	3′-0″ long	8′-0″
Total		44′-0″

44′ represents the lineal feet of lintel section required.

Figure also the lineal feet of sills from actual openings, keeping door and window sills separate where a hollow tile sill is to be used. Frequently, however, the wood sill of window frames is set directly on the tile wall and no other shape provided or required for this purpose excepting where the tile are set on end. A course of tile slab should be used under all frames to cap off and close the cells in the tile, when tile are laid with cells vertical.

Sills:

Door sills	2x3	6 lin. ft.
Window sills	1x6	6 lin. ft.
Window sills	1x5	5 lin. ft.
Window sills	3x4	12 lin. ft.
Gable window sills	2x3	6 lin. ft.
		35 lin. ft.

35′ represents the lineal feet of sill section required.

The vertical lineal feet of jamb for all plain openings is figured for closures and vertical lineal feet of recessed box frame openings for jamb tile.

Where straight wall tile is used for regular lintels, the item for regular lintels is disregarded, otherwise this item would be deducted at an equivalent area in square feet.

Window and door sills, if included, would be deducted at ½ square foot each. Area of jambs to be deducted by averaging the jambs and half-jambs to equal ¾ foot per lineal foot. Closures and half-closures would be similarly averaged. Corner tile will be equivalent to ⅔ to 1½ square foot per lineal foot. Joist course is usually taken to equal one square foot per lineal foot.

Note—When the corner tile are different from the regular wall tile and are to be deducted, the side and end are to be measured. Fig. 113 on page 18 deduct ⅔ sq. ft. Fig. 102 deduct 1.5 sq. ft. Fig. 101 deduct 1.08 sq. ft. Fig. 114 and 115 deduct .8 sq. ft. and add one 2x8x12 tile per lin. ft. of corner.

These items for the house shown on our sketch will be as follows:

Window and door lintels	44 lin. ft. =	44
Door sills	6 lin. ft. =	3
Window sills	29 lin. ft. =	15
Jamb	62 lin. ft. =	46
Closures	28 lin. ft. =	21
Corners (4x14)	56 lin. ft. =	56
Joist course (2x36)	72 lin. ft. =	72
Total		257

Thus we will have approximately 257 square feet to deduct if all these items were to be provided for, giving the reduced area of straight wall tile as 1,897 minus 257 = 1,640, multiplied by 2.4 = 3,936 pieces.

Now then, our completed quantities will read:

3,936 pcs. of wall tile.
44 lin. ft. lintel.
6 lin. ft. door sills.
29 lin. ft. window sills.
62 lin. ft. jambs.
28 lin. ft. closures.
56 lin. ft. corners.
72 lin. ft. joist tile.

SPECIFICATION RECOMMENDED FOR HOLLOW BUILDING TILE CONSTRUCTION

(1) In General:

This Contractor shall furnish all labor and materials, transportation, tools and equipment required to erect the Hollow Tile walls (partitions) and such other work as indicated on the drawings, all in accordance with the best and latest practice and as hereinafter specified; only skilled tile setters or bricklayers accustomed to the laying up of Hollow Building Tile shall be employed.

Contractor shall carefully examine the drawings and provide for the complete and proper construction of all work and shall furnish all steel rods, band iron, anchors, bolts, etc., hereinafter specified to be furnished in connection with the work included under this heading.

This Contractor shall build in all miscellaneous iron work furnished under other contracts and shall co-operate with and assist the carpenter or other contractors in any work which must be jointly executed.

Where the walls are trimmed with brick, cut stone or architectural terra cotta, or where the walls are faced or veneered with brick or limestone ashlar, specify whether this contractor shall set same, furnished by other contractors, or include both the furnishing and setting.

(2) Hollow Tile Material:

All Hollow Building Tile shall be straight, uniform, free from objectionable cracks and burned to such a degree of hardness that it will pass the following requirements:

Use clause "A", "B" or "C" according to the purpose for which the tile is required or specify the salt glazed vitrified tile where that type of tile is desired.

(a) **Standard Loadbearing Tile** shall have an absorption not to exceed 12 per cent and be capable of sustaining a load of at least 700 pounds per square inch of gross area when designed to be laid with the cells horizontal and when tested in that position, and 1200 pounds per square inch of gross area when designed to be laid with the cells vertical and when tested in that position.

For use in walls, in which the tile are to be left exposed to the weather without stucco, cement plastering or other finish.

(b) **Finished Face Tile** shall have an absorption not to exceed 10 per cent and be capable of sustaining a load of at least 700 pounds per square inch of gross area when designed to be laid with the cells horizontal and when tested in that position, and 1200 pounds per square inch of gross area when designed to be laid with the cells vertical and when tested in that position.

For use in foundations or other walls in contact with the earth.

(c) **Vitrified Foundation Tile** shall have an absorption not exceeding 8 per cent, and be capable of sustaining a load of at least 1200 pounds per

square inch over the gross area when tested in the same position as when laid in the wall.

(3) Tests:

Copy of test report certifying that the test requirements have been complied with, indorsed by a recognized testing laboratory, will be accepted by the architect as a satisfactory evidence that the proposed make or brand of tile will fulfill the requirements specified, subject to inspection approval as hereafter specified.

No badly split, cracked, warped or underburnt tile shall be used in the work. All wall tile shall have dove-tail scoring or grooving to form a key for mortar, plastering and stucco and all other tile shall be suitably scored for plastering.

(4) Inspection:

The requirements of inspection are that at least 85% of all material furnished in each carload or teamload shall be equal to the samples approved and comply with the specified crushing and absorption requirements, and the balance shall in the opinion of the architect or his inspector constitute only a fair and usual commercial variation from same, otherwise the entire shipment or such part of same as may be condemned by the inspector shall be culled and immediately removed from the site.

(5) Mortar and Laying:

All mortar used for the setting of Hollow Building Tile shall be composed by volume of one part (approved brand) of Portland cement to three parts clean sharp sand thoroughly mixed to a smooth moderately stiff mortar, to which may be added hydrated lime, not to exceed 15 per cent of the volume of cement.

All hollow tile shall be set with full mortar beds and well filled vertical joints and shall be shoved to a bearing with as close a joint as is consistent with good workmanship, pointing up and filling all crevices.

In absence of such test data or in event of the tile not passing the inspection requirements, the architect may at his option require the product to be tested before approval.

For finished face tile, the following clause should be added: All joints shall be carefully jointed up as the work is laid and shall be ("struck"), ("tucked"), ("slightly raked out"), (or specify any other method of finish desired) and all mortar droppings cleaned off the face of tile with clean water before it sets or adheres, and the work left clean and perfect upon completion.

This contractor shall also furnish the proper protection for his men and for those working under him, as required by the City and State laws.

In some sections of the country where 8 x 5 x 12 building tile laid on the 8" bed is extensively used it is the general custom in building walls for stucco finished buildings to leave the vertical joints open to form an extra key for plastering and stucco. There is no apparent need for this, as the grooved surface of ordinary hollow tile forms an excellent base for the application of stucco and plastering. This method has apparently given entirely satisfactory results and is the source of some slight economy in the cost of laying but is not recommended for general practice, as it relies entirely upon the outside stucco finish for sealing up the dead air spaces and preventing the outside moisture from being communicated to the very dry and consequently highly absorbent air contained within the cellular spaces of the wall, which to render their full value as an insulating medium must be kept dry and free from contact with external atmospheric conditions.

All tile for exterior walls or interior bearing walls shall be set with the hollow spaces in the (vertical or horizontal) position for which the particular form of tile is intended.

All walls shall be bonded by breaking joints in every course at least three inches, and the tile be laid so that the main bearing shells and webs come in proper relation for bearing on those of the tile below or the load distributed by means of tile slabs, brick or concrete. In warm weather all hollow tile shall be thoroughly wetted before use.

Where any special form of tile is used the following clause should be inserted: The details and printed directions of manufacturers of the particular tile shall be followed and are hereby made a part of this specification, except where such details of construction may be inconsistent and conflict with the intent of this specification.

(6) Bearing Wall Design:

The layout and size of hollow tile in bearing walls shall be such that the gross sectional area of the tile is not stressed greater than one-tenth of the crushing strength of the particular tile used, as ascertained by properly conducted test. The superimposed loadings figured shall include the dead and live loads of floors and roof and the weight of wall construction, etc., and in no case shall the blocks be subject to tensile stress, unless suitable steel reinforcement be provided. Where heavy beams or girders are seated on Hollow Tile walls or where other concentrated loads occur, the walls shall be capped with tile slabs, brick or concrete, or otherwise reinforced to properly distribute the load.

In large buildings and where walls greater than 12″ in thickness are required, this clause should be added.

(a) Bearing walls constructed of hollow tile with the cells vertical shall be capped with a course of tile slabs at all floor levels to receive the joist, or other floor construction, also at top of walls under the roof plate, coping or cornice and wherever a reduction in the thickness of walls or blocks is made. The open cells shall also be closed with tile slabs under all door and window sills and at other openings.

(b) Bearing walls built of tile with the cells horizontal shall have the open ends of cells at all door and window or other openings finished with closure tile or be otherwise closed off in approved manner with hollow brick, slabs of tile or cement mortar.

(7) Lintels:

Lintels shall be formed over all openings reinforced as shown by details or by jack arches cut from the regular wall tile. Flat arches may be used up to 5′ 0″ span where the necessary abutment is available. Concrete used for lintels and all other purposes in connection with hollow tile walls to be a 1-2-4 stone or gravel concrete. All interior bearing walls shall be well bonded

and tied into outside walls. Fireplaces and chimneys of hollow tile shall be built as shown and be well bonded into the wall on which they occur.

(8) Foundation Walls:

Where indicated on drawings the foundation walls (and piers) from (top of footing) or (top of masonry) foundation up to first floor level shall be constructed of hollow building tile of the grade specified for foundation walls, using the required size and shape of tile for corners, offsets and similar breaks to maintain the bond and insure properly staggered joints throughout the length of wall.

Where Hollow Tile foundation walls are used, it is generally sufficient to specify that all walls, piers, etc., below grade, shall be plastered with a cement mortar composed of 1 part Portland cement and 2 parts sand, one-half to three-fourths inch thick troweled smooth.

In low, damp ground, water bearing clay or where springs or excessive ground water occurs, the mortar for plastering foundations should be mixed with an approved damp-proof composition. Also where any quantity of ground water is present or known to occur, a dry drain should be laid around the foundation carrying the water away to some convenient point, which may be specified under this heading or be included with the plumbing and drainage work elsewhere specified.

(9) Grade Course:

Specify here the required grade course which may be of stone, salt-glazed tile, vitrified brick or a rich Portland cement concrete, or other non-porous material.

Grade course should be from 9 inches to one foot or more in height, extending 2 or 3 inches below grade, but need not extend more than 4 to 5 inches back from the face of the wall. A through damp course on a line with the top of grade course is often used, but is not required in dense tile walls.

The stucco finish on Hollow Tile walls may be carried down to finish below grade but in the better class of buildings, this is not advisable on account of the destructive action of frost, which is a tax on any building material and is most severe at this point.

One very satisfactory solution of the problem is to build the foundation of an impervious salt-glazed tile up to about 1′ 0″ above grade line and the regular standard building tile above this point, having the stucco on the tile above grade finish down on top of the salt-glazed tile, the top course of which may be arranged to form a belt course.

(10) Exterior Walls and Interior Bearing Walls:

Exterior walls above foundation and all interior bearing walls shall be constructed of the (several) thickness as indicated on drawings, forming all corners, returns and offsets as shown and using the required shape and size of tile to work up to corners and openings and to maintain proper bond throughout the length of wall.

For all openings at double hung windows special jamb and jack arch lintel tile shall be provided.

All window sills to be formed of special sill tile.

Window and door lintels (unless steel lintels are called for) where too wide for jack arches, shall be

Where it is desired to use Hollow Building Tile for exterior walls, exposed to weather without the use of stucco, brick-veneer or other facing, specify the tile to conform to the requirements for finished face tile (see Pf. 2b) or specify the vitrified salt-glazed tile where that type of tile is desired.

constructed of Hollow Tile reinforced and filled with concrete as indicated, providing for at least one hollow space throughout.

Hollow brick size tile or brick or tile slabs shall be provided wherever required to work up to story heights, windows, sills, etc., and all blocking up of joist to be done with tile or brick.

Where arches occur in walls they shall be formed of two (or more) coarse rowlock arch of common or hollow header brick turned on suitable centers.

(11) Porch Columns and Piers:

Columns and piers where so indicated, shall be constructed of Hollow Building Tile of the sizes required to give the finished outlines shown on drawing, where round columns are indicated, they shall be constructed of hard burned round column fireproofing tile.

When columns and piers using end construction are to carry concentrated or heavy loads, specify that they shall be reinforced with rods or by placing galvanized diamond mesh expanded metal or woven wire lath in the mortar joints between courses.

(12) Chimney:

All chimneys shall be constructed of Hollow Building Tile.

Construct all rough fireplaces with arch or reinforced lintels over rough openings, using common brick where required to form the jambs and throats, and for trimmer arches. Flat arch over finished fireplace openings to be reinforced with one-half inch by two inch bar securely anchored into the jambs.

Provide all chimneys with fire clay flue linings of the size indicated on drawings, which shall be carefully set, breaking joints with the Hollow Tile, wiping out all joints as the sections are erected.

Care should be exercised to see that proper provision is made for the flashing of chimneys at roof line, also that they are properly capped off with weatherproof chimney cap. Build in cast iron clean out door at the foot of all flues and the cast iron (or terra cotta) thimbles as indicated.

(13) Chimney Cap:

Provide chimney caps cast in place on top of chimneys of a (3″) 4″ thick slab of 1-2-4 concrete trowelled smooth.

Provide red (or buff) terra cotta chimney pots as indicated on drawings (or allow the sum of .....dollars for the chimney pots which will be selected by the architect).

Chimney pots should be of a size that will fit the flues over which they are set.

(14) Fireplaces

The finished brick or tile facings, linings and hearths are not to be included under this contract.

(15) Copings or Crestings:

Specify here the finish on top of walls that are not covered or capped by the roofing (also that such walls, if of tile set on end, shall be capped with a course of tile slabs before the coping or cresting is set).

(16) Roof Plates:

Build in all exterior walls covered by roof, ¾″ anchor bolts about 5′ 0″ or 6′ 0″ c-c, to have nut and washer projecting 4″ above the top of tile for the anchorage of roof plate. These bolts to be solidly built into the wall by partly filling the tile around same with cement mortar or concrete.

(17) Nailing Plugs:

Metal nailing plugs may be built into the joints of walls but a better method is to specify under "Carpentry" that the plaster grounds and nailing are to be fastened to the Hollow Tile walls with clinching nails, screw sockets or other approved fastenings.

Wood blocks that must be built in the joints should never be used for nailings in Hollow Tile exterior or bearing walls; but it is permissible to plug the cells of tile with wood blocks when this method is feasible.

(18) Frame Anchorage, Wind Check and Caulking:

As in other masonry buildings, regardless of how carefully the window frames may be built in, the shrinkage of the wood frame will eventually let in some cold air and to prevent this it is best in good work to specify caulking, but in all cases anchorage and wind checks should be specified as follows:

Specify under "Carpentry Work" that all plank window and door frames shall have two thin wood strips (two thicknesses of ordinary plastering lath will do) nailed on the backs of frame so that they will be blocked out from the face of tile in jamb and be set with a cement mortar anchorage and wind check.

This detail provides a caulking groove at back of frame and where caulking is also required it should be specified under "Carpentry Work" as follows:

Caulk around all door and window frames that are set in exterior hollow tile walls with dry oakum which shall be driven in tightly, filling the groove or recess provided to a depth of at least 1 inch.

(19) Partition:

All partitions and division walls other than bearing walls, shall be constructed of light weight Hollow Partition Tile of the several thicknesses indicated, all to be built true to line and plumb and all intersections to be bonded or well tied together and into the walls; all partitions to be set in cement mortar as specified for wall tile and be bonded by breaking joints at least 3″ in every course, having all joints well filled with mortar. Where there are more than two courses of tile over the heads of

For use when the building is of all-fireproof construction.

door or other openings and over all openings wider than 3′ 6″ jack arches of partition tile or suitable reinforcement of wire fabric, light steel sections or strap iron shall be provided. All main partitions, stair and elevator enclosures shall start on the structural floor and be wedged up tight against the structural ceiling or beam above.

(20) Cutting and Patching:

This contractor shall do all cutting and patching of his work required for the proper installation of work by other trades, any unnecessary cutting and repairing to be reported to the architect for adjustment with the contractor for whom such work is done. This contractor shall leave all chases and openings required by other trades and build in all anchors, or other accessories furnished by others. All chases and openings that are built or cut into the walls shall, when ready for plastering, be covered with No. — gauge galvanized diamond mesh expanded metal lath or woven wire lath by (this) or (plastering) contractor. Lath to be securely tied into place lapping the face of tile by at least 2″ on each side to prevent cracking of the plaster. Upon completion, do any patching required and remove all rubbish, equipment and surplus material.

Contractors for plumbing, heating and electric work, and other trades will not be permitted to cut into the Hollow Tile walls without permission from the tile masonry contractor and generally any cutting and repairing shall be done by the tile mason and the cost charged to the contractor requiring same. Contractors for other trades must therefore arrange the installation of their work so that openings and chases may be built in where required, or furnish to, and co-operate with, the mason contractor in setting the sockets, ferrules, pipings, conduits, outlet boxes and fastenings that must be built into the Hollow Tile walls. Horizontal chases will not be permitted in tile walls.

SPECIFICATIONS FOR HOLLOW BUILDING TILE

Hollow Tile shall be uniform, straight, free from objectionable cracks and be manufactured in such a manner and burned to such a degree of hardness that it will have an average absorption of not over 12% and develop an average crushing strength of not less than 700 pounds per square inch of gross area when designed to be laid with the cells horizontal and when tested in that position, and 1200 pounds per square inch of gross area when designed to be laid with the cells vertical and when tested in that position.

Smooth face tile or other tile for use in exterior walls without stucco finish should be specified to have an absorption of not over 10 per cent.

Tile for use in foundation walls in saturated soil or where constantly subjected to subsurface water and the action of frost should be specified to have an absorption of not over 8 per cent.

FIRE-PROOFED BUILDINGS

Fireproofing experts generally agree that there are four things to be expected of a so-called fireproof building:

First—That it shall fully protect the human inmates and provide ample safe means of egress and protection against panic in case of fire.

Second—That it shall preserve its contents from any ordinary fire originating within or outside the building.

Third—That the building, particularly the structural parts thereof, shall withstand any fire successfully.

Fourth—That every fireproof building shall be a barrier to conflagration or the spread of fire.

In the past, the serious fireproof building losses except in conflagration were invariably due not to faulty construction or fireproofing, but to large undivided areas of unprotected vertical openings, improperly enclosed shafts and lack of window protection.

Any good-sized fire will produce a temperature up to 1,800 and 2,000 F., and a fire which has a particularly large amount of combustible material to feed on, even in a fireproof building, with good draft conditions, may develop temperatures several hundred degrees higher. Some fires are authentically known to have gone higher than 2,200 degrees F., a temperature that will melt some surface clay bricks and destroy nearly every other so-called fireproof material. High-grade fire clays and shales are the only known materials that will withstand such temperatures, and these not without some damage.

Glass will melt at 1,600 to 1,700 degrees F.; concrete begins to dehydrate at 500 degrees F., and structural steel rapidly loses its strength at 1,000 to 1,200 degrees F. and is incapable of sustaining its own weight at 1,700 degrees. Therefore it will be seen that the temperature of around 2,000 degrees F. that may occur in any large fire can do tremendous damage to any fireproof building, particularly if improperly designed or built, and the whole theory of fireproof building construction must rest upon so designing and building the structures that such temperatures can never occur; also that the spread of any fire will be so retarded that it may easily be extinguished before any extensive material damage occurs.

Hollow Tile, properly manufactured and applied, will provide the greatest measure of protection and safety that can be afforded by any building material. Where failures have occurred it is because, in the efforts to hold down the cost, the proper structural features and fireproofing methods have not been followed.

The principal forms of fireproof building construction may be stated as follows:

For the tall office building, hotel or apartment, steel frame with tile arches, fireproofing and partitions—steel frame with concrete arches, tile fireproofing and partitions.

For the fireproof structure of moderate height, steel frame, tile or concrete floors, tile fireproofing and partitions—long span floors of tile and concrete, either on steel or reinforced concrete frame with tile fireproofing and partitions. All reinforced concrete structures with tile partitions.

For low buildings, factories, reinforced concrete frame with long span floors of tile and concrete, tile partitions; steel frame with similar long span floor and tile partitions. Steel frames with tile arches and fireproofing.

Hollow Tile, as will be noted from the above, is therefore a most important factor in fireproof building construction.

The term fireproofing is objected to by many, but is here used to qualify materials that are proof against damage from any ordinarily severe fire.

Architects and Engineers in the past have been inclined to be lax in requiring good workmanship in the setting of fireproofing tile. Contractors have permitted the improper and unnecessary cutting into same by other trades, and the most excellent showing that this product has shown under severe test by fire when abused in this manner is

an unfailing testimony of the excellence of this product as a structural fireproofing material.

It is largely with a view to avoiding such practices and guiding the building profession in the best and proper methods that this handbook has been prepared.

Hollow Building Tile has already merited a very extensive usage and can be depended on to fulfill every claim that is made for it as the most economical, universal and satisfactory fireproofing material, if the details and practices as outlined herein are followed.

Floor Construction:

For the tall office building, hotel, apartment building or department store, and in fact for all highly specialized commercial structures within the built-up business sections of the cities, where rapidity of erection, probable change of occupancy and other factors must be considered, a structural steel frame must invariably be used, in connection with which the flat arch of hollow tile cannot be excelled.

Hollow Tile arches, both flat and segmental, are fireproof, light in weight, can be erected or removed in a minimum of time, and can be erected at any time of the year regardless of temperature and weather, before, after, or at the same time the walls are built.

With all ordinary depths of floor beams, Hollow Tile flat arches can be of such depth as will give a level ceiling without increasing the weight of floors by excessive filling.

The false work or centering may be removed within 24 hours after the arches are set, and they may be plastered the day after being set when it is necessary to rush the work. Also, the cement mortar joints in tile arches dry out rapidly, permitting of the immediate laying of finish flooring and wood trim without damage from moisture. Cinder concrete floor filling may be eliminated by the use of Hollow Tile floor fill, further reducing the amount of moisture introduced into the building.

Hollow Tile arches facilitate the economical design of structural steel, as they weigh less per square foot than any other form of fireproof floor construction of equal strength, and consequently in tall buildings greatly reduce the dead load on structural steel and foundations; they further assist in the wind bracing by rigidly filling the full depth of beams, and act as a horizontal brace for the entire structure at each story level.

Hollow Tile arches are excellent non-conductors of sound, which is an extremely important consideration in hotels, hospitals, bank, office and other commercial buildings.

Tile arches give the best ceiling on which to apply plaster.

Long-Span Floor Construction:

One of the modern developments in building construction is the so-called "long-span," which eliminates the intermediate floor beams by spanning the distance between supporting girders located on the lines of columns. There have been numerous long-span floor schemes developed, quite a few of which are patented, but of all these the simplest and most universally adaptable is the combination of "T" section reinforced concrete joist beams with Hollow Tile fillers between. This system is not covered by any basic patent, can be used by anyone, and is composed of elements readily obtained in any market, also any type or style of reinforcing rod may be used. One of its greatest advantages is the solid plastering surface for ceiling on under side. The economy in form work is another.

Electric conduit may be bedded in the construction the same as in solid concrete slabs, only architects should give some consideration to the layout of conduits or other piping and avoid diagonal or cross runs through the compression area and provide a greater thickness of concrete by using thinner tile filler where a concentration of conduits occur around wire shafts or cut-out closets. Ordinary hard burned light partition tile are used in this type of floor construction, which is shown on page 12 and for which designing data is given on pages 75 and 76.

The cells of tile at ends of rows should be closed, and this is very easily accomplished on the job by setting up on end, on the forms or on a plank platform, the required number of tile, and pouring a half inch of fine concrete

or mortar into bottom of cells. This should be done about one or two days ahead of the pouring of concrete.

The joints between tile in adjacent rows should be staggered, and to accomplish this half length tile are used for starters or closers in alternate rows.

This type of floor construction is equally well adapted to either reinforced concrete or steel beam construction, and when carried on steel beams the fireproofing of beams and support for long-span floor may be either of concrete or Hollow Tile. (See alternate details shown in Fig. 1047-B on page 77.) Where the supporting steel member is small, concrete covering may be found the most suitable, but where the support member is a large or wide flange beam or built-up girder, the weight of concrete to encase same would be considerable, and Hollow Tile fireproofing is generally better.

See page 12 for dimensions and weights of tile for floor construction.

In addition to these, in order to meet the demand for deeper floors of greater span, some manufacturers are now making special filler tile up to 20″ in width, and, for ordinary loads, spans up to and even over 25′ can be very economically constructed.

FIREPROOF SYSTEMS AND HOLLOW TILE ARCHES.

The following is quoted from the nineteenth edition of the Carnegie Steel Company's Handbook which should be consulted for complete data on the tie rods for use with Hollow Tile arches.

The term terra-cotta as used in this handbook applies to the structural material generally designated as Hollow Building Tile or Hollow Tile fireproofing.

Fireproof Floor Systems:

A modern office or mercantile building is essentially a steel framed structure which supports the dead load of the building and its contents and is itself protected on all sides by refractory materials. The floors are made fireproof by the use of terra cotta tile or arches, or of a composite flooring made of concrete or reinforced concrete. While brick arches may still be used in special locations where great floor strength is needed, and concrete arches are sometimes thrown between the beams, modern practice is limited substantially to the hollow tile arch sprung between the beams and the reniforced concrete slab laid on their tops, the ceiling construction being modified to suit. Each system has advantages of its own.

Terra Cotta Arches:

Hollow Tile arches fill the total depth of the floor beams, and, therefore, tend to stiffen and brace the building; their weight per square foot is light as compared with other forms of fireproof floor construction of equal strength. Hollow terra cotta floor arches are made either flat or segmental. The segmental arch will develop much greater strength than the flat arch of the same width and depth, and may be designed to carry a given load with tile of less depth than flat arches. They are, therefore, more economical, though not always acceptable from the standpoint of architectural appearance. In office buildings the ceilings under such arches are usually suspended. A correctly designed and constructed flat arch will always develop the full strength of the steel beam which supports it.

When arch blocks are the same depth as the beams, they are usually laid to project one and one-half inches below the bottom of the beams, and the space above the arch is filled in either with cinder concrete, in which can be laid pipes, conduits, and wooden nailing strips supporting wood flooring, or with thin terra cotta blocks made for this purpose, or with a layer of plastic composition of cement, which forms the wearing surface for the floor.

Thrust of Floor Arches:

All forms of terra cotta arches produce side thrust on the floor beams. In the flat arch the blocks have tapered faces and the central block or key, wedges the others together; in the segmental arch the thrust is that due to all arch action. These thrusts it is found necessary to counter-balance by means of tie rods which connect the floor beams and relieve them from the tendency to deflect sidewise. In the central bays, owing to the action of adjacent arches, the tie rods are sometimes omitted, but it is necessary to investigate outer beams and channels around openings for additional thrust stresses so that the combined fiber stresses produced by vertical loading and horizontal thrusts may not be excessive. With flat arches three-fourths inch tie rods spaced apart not over fifteen times the width of the beam flanges will usually be sufficient.

COMBINATION LONG SPAN FLOORS ONE-WAY SYSTEM

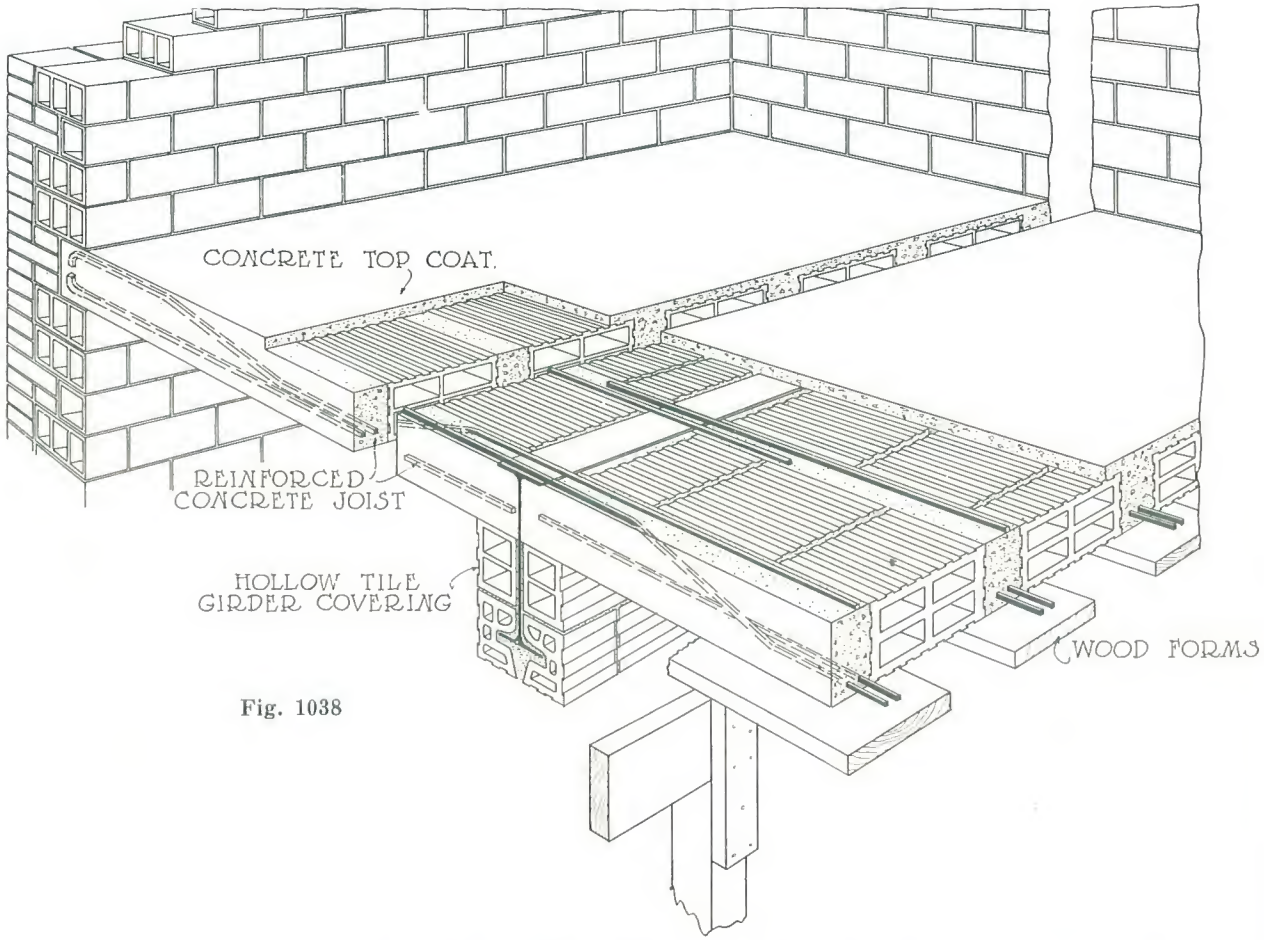


Fig. 1038

Combination reinforced concrete and hollow tile system floors are particularly adapted to all classes of buildings where medium or long span fireproof floors are required without intermediate or cross beams showing in the ceilings. This construction reduces the dead load of reinforced concrete and provides a good plastering surface.

This system of long span floor construction is particularly well adapted to apartment houses, institutions and schools designed for wall bearing construction, where interior piers or columns and girders are omitted giving a clear span from wall to wall.

Much in the same way that the modern I-beam was developed from the original rectangular beam by cutting away the inert material on either side until the I shape was developed, so the modern combination long-span hollow tile and concrete floor slab was developed from the original solid slab by cutting away the inert concrete below the neutral axis until a series of connected T-shape beams remained. Hollow Tile make permanent forms in which are cast the series of connected concrete T's as shown on page 76.

By eliminating the inert concrete and substituting hollow tile, the dead weight of the floor construction is greatly reduced. (See table of weights on page 74.)

The One-Way system shown above in which the T-beams run in one direction is the most efficient form of long span floor. When constructed of 6-inch tile spaced 4 inches apart and covered with a 2-inch concrete top, this floor has only 44 per cent of its volume in concrete, 56 per cent being hollow tile.

This floor construction is equally adapted to use with an all reinforced concrete frame with added advantages as the thickness of the floor construction permits the most economical design of T girders. Flanges may be made the full thickness of slab by stopping the tile fillers at any distance from the girder stem that the T width may require. This overcomes the extremely wide thin T flanges that limit the design of T girders in solid slab construction.

With reinforced concrete and T girders, when the compression stress at negative moment over point of support can be provided for, it is customary to design this floor for full continuous action in the central spans by the formulae $M = \frac{Ml^2}{12}$

Cost of Plastering:

Plastering on ceilings formed by either flat hollow tile arches or combination floors costs less than on most any other material. Because first, only two coats (instead of three) are necessary; second, considerable labor is saved because the plastering surface is flat and unyielding; third and most important of all, the plastering surface is formed automatically in building the floor slab, and on removing the forms the ceiling is ready for plastering without the installation of any other material, the cost of which including its erection is also saved.

Temperature Reinforcement:

Changes in temperature from Winter to Summer will not cause cracks in hollow tile floor slabs, or in the plaster applied to them. Stresses due to these temperature changes are absorbed at the points where they arise and are not transmitted to accumulate at the points of anchorage at the partitions. The perfect adhesion between the concrete and the tile, bonds the two materials so strongly as to make them act as one material. Reinforcement in the concrete top of hollow tile floors is not necessary.

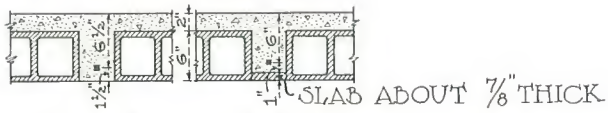
Strength of Floor:

T-shaped joists of reinforced concrete carry the load on one-way floors. The function of the tile is to serve as a permanent form in which the joists are cast, to fireproof the load-carrying concrete in the slab and joists, to stay the stems of the T's, to assist in taking up temperature stresses, to eliminate the inert concrete by substituting hollow tile for the dead weight concrete, and to furnish a good plastering surface. All calculations for the concrete joists which carry the load and form the structural part of the floor are based on the universal accepted engineering practice for T-beam design, and are readily subject to analysis.

In the one-way system, the tile in a line of units are all in contact and hold each other securely in their correct positions. They are not displaced by the workmen in pouring the concrete. No re-alignment is necessary. The joints between tile in adjacent rows should be staggered by starting alternate rows with half lengths.

The naturally strong adhesive bond between tile and concrete, aided by the mechanical bond of dove-tail scoring cause the two materials to act as if they were monolithic. (All concrete for floor construction should be mixed to a "quaking" consistency.) The tile and concrete are so firmly united that a chisel and sledgehammer would have to be used to separate them.

All-Tile Ceiling:



Some architects favor a ceiling with a tile surface over the entire area, for which purpose a tile slab is laid between the hollow tile blocks. This is heavily scored on both sides so as to furnish a secure bond with the concrete joist above and the plaster ceiling below. When the all-tile ceiling is called for it is impossible to provide the same load carrying capacity without increasing the slab thickness because the depth of the concrete joist and the distance of the reinforcing bar from the top of the slab is reduced by an amount equal to the thickness of the tile slab. This is shown in the typical cross-section herewith. The reinforcement must be held off the tile so that

the concrete can flow under the steel. If the bars were allowed to lay on the tile slab they would be at about the same distance from the top of the slab and have the same value in tension as they would if the all-tile ceiling were not specified. In this position, however, they would not develop more than three-quarters of their adhesive bond with the concrete.

Fire Resistive Qualities:

In these floors, Hollow Tile around which the concrete T-beams are cast, fireproofs the load-carrying concrete of the beams (above the neutral axis and therefore in compression), against the flames of a fire below. In combination floors the only concrete exposed to the flames is the bottom of the stems of the T-beams, which is designed only as fireproofing for the reinforcing bars. Experience with fires shows that some of this concrete would spall off where the heat was intense, but cement mortar can be plastered over these places furnishing new fireproofing for the steel. With hollow tile floors the plastering surface remains practically undamaged after a fire, and can be replastered readily at comparatively slight expense.

Permanency:

Combination floors of tile and concrete are a permanent construction and, for all practical calculation, can be said to have no depreciation. There are many structures standing today which were built 2,000 years ago of concrete made from cement which was inferior to our modern synthetic cement. All the examples of tile work which have come down to us are so ancient that the date of their manufacture can only be conjectured. It has been demonstrated by the wrecking of old reinforced concrete structures that the imbedded steel does not rust but is preserved by the cement. There is no reason why a modern fireproof, sanitary schoolhouse, hospital or residence with floors constructed of concrete and hollow tile should not last and give service for hundreds of years.

WEIGHTS OF COMBINATION FLOORS AND QUANTITY OF CONCRETE REQUIRED

Thickness of Tile	3″	4″	5″	6″	7″	8″	9″	10″	12″	15″
ONE-WAY—2″ Concrete Top—4″ Joists, 16″ on Centers										
Weight per sq. ft. of floor area	45 lbs.	50 lbs.	55 lbs.	60 lbs.	65 lbs.	70 lbs.	75 lbs.	80 lbs.	90 lbs.	105 lbs.
Cu. ft. concrete per sq. ft. floor	0.229	0.250	0.271	0.292	0.313	0.333	0.354	0.375	0.417	0.479

WEIGHT AND AREAS OF REINFORCING BARS

Size in Inches	¼	⅜	½	⅝	¾	⅞	1	1⅛	1¼
SQUARE BARS									
Area in Square Inches	.063	.141	.250	.391	.563	.766	1.000	1.266	1.563
Weight per foot in lbs.	.21	.48	.85	1.33	1.91	2.60	3.40	4.30	5.31
ROUND RODS									
Area in Square Inches	.049	.110	.196	.307	.442	.601	.785	.994	1.227
Weight per ft. in lbs.	.17	.38	.67	1.04	1.50	2.04	2.67	3.38	4.17

DATA FOR DESIGNING LONG SPAN COMBINATION FLOORS
ONE-WAY SYSTEM OF REINFORCEMENT

The upper figures in table denote the depth of tile; the lower figures indicate the area of reinforcing steel required in each concrete joist. Thickness of floors equals the depth of tile plus the 2″ concrete top.

The tables below and on the following page are so arranged that they can be used for floor slabs freely supported at both ends, semi-continuous or continuous.

For slabs freely supported at both ends (simple span) use load given opposite $\frac{WL}{8}$

For slabs freely supported at one end and continuous over other support use loads given opposite $\frac{WL}{9}$, or, if building code permits, $\frac{WL}{10}$

For slabs continuous over both supports use loads given opposite $\frac{WL}{10}$, or if building code permits $\frac{WL}{12}$

For semi-continuous spans proper reinforcement must be provided in top of slab over support to take care of negative bending moment. Where heavy loads and short spans occur, the vertical and longitudinal shear must be determined and shear reinforcement provided when necessary.

Table Based on
fc. 650 lbs. per sq. in.
fs. 16000 lbs. per sq. in.
Ec / Es = 1 / 15

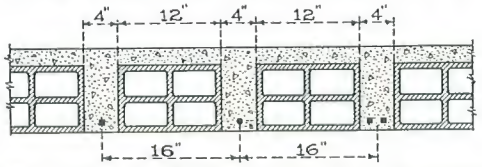
2″ Concrete Top Slab
¾″ of concrete below reinforcement
4″ concrete joists
16″ on centers

Bending Moment	TOTAL SAFE LOADS (Dead and Live)											
$\frac{W\ L}{12}$	150	165	180	195	210	225	240	260	300	335	375	450
$\frac{W\ L}{10}$	125	135	150	160	175	185	200	220	250	280	310	375
$\frac{W\ L}{9}$	110	120	135	145	155	170	180	195	225	250	280	335
$\frac{W\ L}{8}$	100	110	120	130	140	150	160	175	200	225	250	300
Span 6′-0″						3/.19	3/.20	3/.22	3/.26	3/.29	3/.32	3/.39
" 7′-0″		3/.19	3/.21	3/.23	3/.24	3/.26	3/.28	3/.32	3/.35	3/.38	3/.44	4/.42
" 8′-0″	3/.23	3/.25	3/.27	3/.30	3/.32	3/.34	3/.37	3/.40	3/.46	4/.41	4/.46	4/.55
" 9′-0″	3/.29	3/.32	3/.35	3/.37	3/.39	3/.41	3/.43	4/.40	4/.46	4/.52	4/.58	5/.57
" 10′-0″	3/.36	3/.39	3/.43	3/.46	4/.40	4/.43	4/.46	4/.50	4/.57	5/.53	5/.59	5/.71
" 11′-0″	3/.43	3/.47	4/.42	4/.45	4/.48	4/.52	4/.55	4/.61	5/.57	5/.64	5/.72	6/.73
" 12′-0″	4/.41	4/.45	4/.49	4/.53	4/.58	5/.51	5/.55	5/.60	5/.68	6/.65	6/.72	7/.78
" 13′-0″	4/.48	4/.53	4/.58	5/.52	5/.56	5/.60	5/.64	5/.70	6/.68	6/.77	7/.76	8/.80
" 14′-0″	4/.56	5/.51	5/.56	5/.60	5/.65	5/.69	6/.63	6/.69	6/.79	7/.79	8/.78	9/.85
" 15′-0″	5/.53	5/.58	5/.64	5/.69	6/.63	6/.68	6/.72	6/.79	7/.81	8/.81	8/.89	10/.88
" 16′-0″	5/.60	5/.68	5/.72	6/.67	6/.72	6/.77	7/.74	7/.81	8/.81	9/.84	9/.93	12/.83
" 17′-0″	5/.68	6/.64	6/.70	6/.75	6/.81	7/.78	7/.83	8/.80	9/.84	10/.84	10/.94	12/.93
" 18′-0″	6/.65	6/.72	6/.78	7/.76	7/.82	8/.77	8/.82	8/.90	9/.94	10/.95	12/.87	15/.83
" 19′-0″	6/.73	6/.80	7/.78	7/.84	8/.80	8/.86	9/.84	9/.92	10/.95	12/.87	12/.97	15/.93
" 20′-0″	6/.81	7/.79	8/.76	8/.82	8/.89	9/.87	9/.93	10/.91	12/.86	12/.97	15/.86	15/1.03
" 21′-0″	7/.79	8/.77	8/.85	8/.91	9/.89	10/.86	10/.92	12/.83	12/.95	15/.85	15/.94	
" 22′-0″	8/.77	8/.84	9/.84	9/.91	10/.88	10/.94	12/.83	12/.91	15/.83	15/.93	15/1.04	
" 23′-0″	8/.84	9/.84	9/.91	10/.89	10/.96	12/.85	12/.91	12/.99	15/.90	15/1.02		
" 24′-0″	9/.84	9/.92	10/.90	12/.80	12/.87	12/.93	12/.99	15/.87	15/.99			
" 25′-0″	9/.91	10/.89	12/.81	12/.87	12/.94	12/1.0	15/.86	15/.94	15/1.07			

DATA FOR DESIGNING LONG SPAN COMBINATION FLOORS

ONE-WAY SYSTEM OF REINFORCEMENT

Factor of safety of 7 based on the ultimate crushing strength of the tile, which in practice with cement mortar joints works out to about 4 or 5.



Where special conditions occur it is frequently an advantage to have the work specially designed. For deep floor with heavy reinforcement the concrete joist should be made from ½ to 2 inches greater in width.

NOTE—Either one or two rods may be used in each rib, where continuous action is figured it is customary to use two rods, one of which is bent up at quarter joints and carried over bearing into adjoining span as reinforcement for negative bending moment.

Table Based on
fc 700 lbs. per sq. in.
fs.18000 lbs. per sq. in.
Ec / Es = 1 / 15
2″ Concrete Top Slab
¾″ of concrete below reinforcement
4″ concrete joists
16″ on centers

Bending Moment	TOTAL SAFE LOADS (Dead and Live)											
W L / 12	150	165	180	195	210	225	240	260	300	335	375	450
W L / 10	125	135	150	160	175	185	200	220	250	280	310	375
W L / 9	110	120	135	145	155	170	180	195	225	250	280	335
W L / 8	100	110	120	130	140	150	160	175	200	225	250	300
Span 6′-0″						3/ /.17	3/ /.18	3/ /.20	3/ /.23	3/ /.26	3/ /.29	3/ /.34
" 7′-0″		3/ /.17	3/ /.18	3/ /.20	3/ /.22	3/ /.23	3/ /.25	3/ /.28	3/ /.31	3/ /.34	3/ /.39	4/ /.37
" 8′-0″	3/ /.20	3/ /.22	3/ /.24	3/ /.26	3/ /.28	3/ /.30	3/ /.32	3/ /.35	3/ /.41	3/ /.46	4/ /.40	4/ /.49
" 9′-0″	3/ /.26	3/ /.28	3/ /.31	3/ /.34	3/ /.36	3/ /.38	3/ /.41	3/ /.45	4/ /.41	4/ /.46	4/ /.51	5/ /.51
" 10′-0″	3/ /.32	3/ /.35	3/ /.38	3/ /.41	3/ /.44	4/ /.38	4/ /.40	4/ /.44	4/ /.51	4/ /.57	5/ /.53	5/ /.63
" 11′-0″	3/ /.38	3/ /.42	4/ /.37	4/ /.40	4/ /.43	4/ /.46	4/ /.49	4/ /.54	5/ /.51	5/ /.57	5/ /.64	6/ /.65
" 12′-0″	3/ /.46	4/ /.40	4/ /.44	4/ /.47	4/ /.51	4/ /.55	5/ /.48	5/ /.53	5/ /.60	5/ /.68	6/ /.64	7/ /.69
" 13′-0″	4/ /.43	4/ /.47	4/ /.51	4/ /.56	5/ /.50	5/ /.53	5/ /.57	5/ /.62	6/ /.60	6/ /.68	6/ /.76	7/ /.81
" 14′-0″	4/ /.50	4/ /.55	5/ /.50	5/ /.54	5/ /.58	5/ /.62	5/ /.66	6/ /.61	6/ /.70	7/ /.71	7/ /.78	8/ /.83
" 15′-0″	4/ /.57	5/ /.52	5/ /.57	5/ /.62	5/ /.66	6/ /.60	6/ /.64	6/ /.70	7/ /.72	8/ /.72	8/ /.79	9/ /.87
" 16′-0″	5/ /.54	5/ /.59	5/ /.65	6/ /.60	6/ /.64	6/ /.69	6/ /.73	7/ /.72	8/ /.72	8/ /.81	9/ /.82	10/ /.89
" 17′-0″	5/ /.61	5/ /.67	6/ /.62	6/ /.67	6/ /.72	7/ /.69	7/ /.74	7/ /.81	8/ /.81	9/ /.84	10/ /.83	12/ /.83
" 18′-0″	5/ /.68	6/ /.64	6/ /.69	6/ /.75	7/ /.73	7/ /.78	8/ /.73	8/ /.80	9/ /.83	10/ /.84	10/ /.93	12/ /.93
" 19′-0″	6/ /.64	6/ /.71	7/ /.69	7/ /.75	7/ /.81	8/ /.76	8/ /.81	9/ /.81	10/ /.83	10/ /.94	12/ /.87	15/ /.83
" 20′-0″	6/ /.71	7/ /.70	7/ /.77	8/ /.73	8/ /.79	8/ /.84	9/ /.82	10/ /.81	10/ /.92	12/ /.86	12/ /.97	15/ /.92
" 21′-0″	7/ /.71	7/ /.77	8/ /.74	8/ /.81	9/ /.79	9/ /.85	10/ /.81	10/ /.89	12/ /.84	12/ /.95	15/ /.84	15/ /1.01
" 22′-0″	7/ /.77	8/ /.75	8/ /.82	9/ /.81	9/ /.87	10/ /.85	10/ /.89	12/ /.81	12/ /.93	15/ /.83	15/ /.92	
" 23′-0″	8/ /.74	8/ /.82	9/ /.81	9/ /.88	10/ /.86	10/ /.92	12/ /.81	12/ /.87	15/ /.81	15/ /.91	15/ /1.01	
" 24′-0″	8/ /.81	9/ /.81	9/ /.89	10/ /.86	10/ /.93	12/ /.83	12/ /.88	12/ /.97	15/ /.88	15/ /.99		
" 25′-0″	9/ /.80	9/ /.88	10/ /.87	10/ /.94	12/ /.85	12/ /.90	12/ /.96	15/ /.84	15/ /.95			

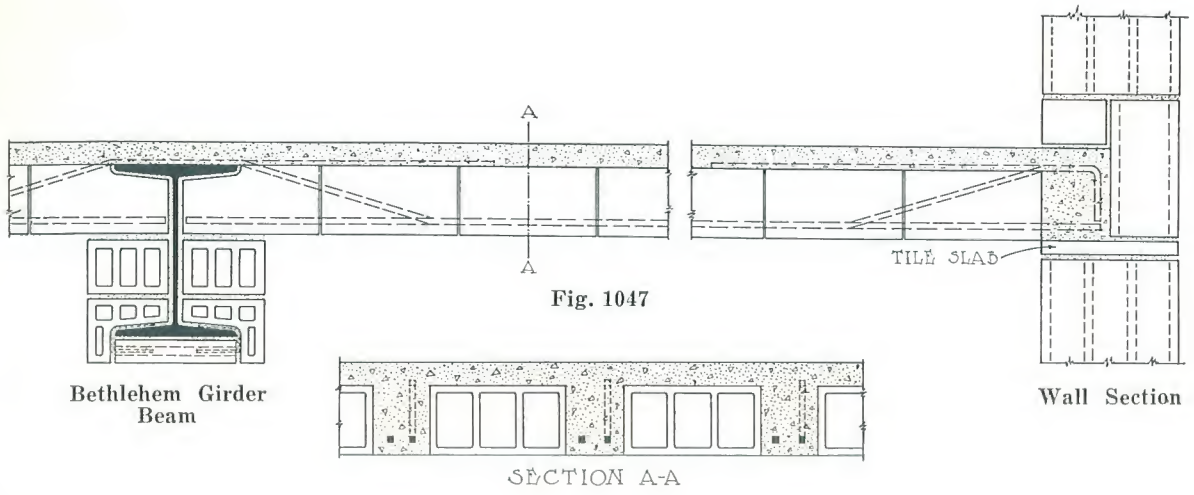


Fig. 1047

Bethlehem Girder Beam

Wall Section

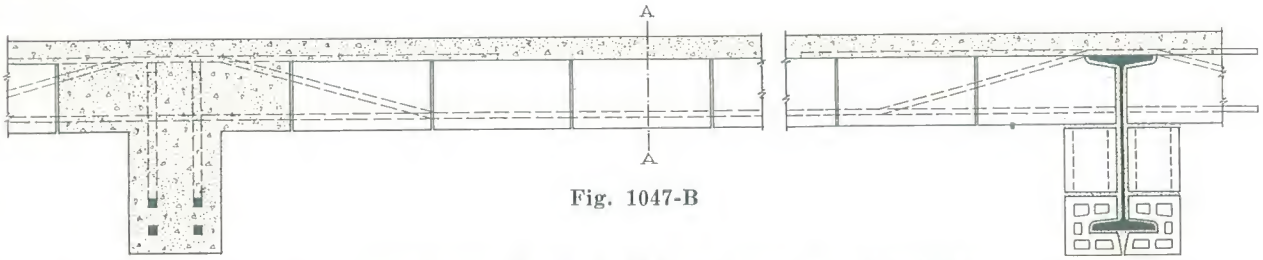


Fig. 1047-B

Reinforced Concrete T Beam

Longitudinal Section of Typical Long Span Combination Tile and Concrete Floor Slab Showing Different Methods of Support.

Standard I Beam

SPECIFICATION NOTES ON LONG SPAN COMBINATION FLOORS

General:

In general the One-Way system consists of 4-inch reinforced concrete joists running in one direction spaced 16 inches on centers with Hollow Tile fillers. All tile are covered with a full 2-inch concrete top, cast monolithic with concrete joists. All floor slabs should have at least a 4-inch bearing on the walls.

Concrete:

All concrete used in the floor construction shall consist of one part approved brand of Portland cement, two parts clean sharp sand, and four parts broken stone or gravel of such size as will pass through a three-quarter inch ring. It shall be a moderately wet mixture and must be well spaded and worked around the reinforcing steel after pouring. The placing of concrete must be a continuous operation, and the full depth of floor must be poured at one time. All tile must be wet before concrete is placed, so as to insure a good bond. When the slab cannot be completed at a single operation, the work shall be stopped along the center of a row of tile with a vertical joint. In pouring the ribs the concrete should not be dumped into the joist but on the previously placed concrete and be worked forward allowing the mortar to flow ahead in the joist.

Reinforcing Steel:

Rolled, deformed, or cold twisted bars of mild or medium steel offering a mechanical bond with the concrete satisfactory to the architect are to be used as reinforcement for the floor construction. They are to be free from mill and rust scales. No bars pitted by rust are to be used. Reinforcement should be placed so as to allow ¾ of an inch of concrete between the steel and the forms.

Tile:

The depth of hollow tile fillers and the size of steel reinforcing rods are determined by the span and load to be carried and should be indicated on structural drawings. Master Tile should be used as it is hard burned, free from damaging impurities, and properly scored on all exterior surfaces.

Forms:

Forms must be of such size lumber and be so braced as to prevent deflection under the weight of the wet concrete, and must be provided in such quantity as to permit speedy work. Care must be taken not to remove the forms before the concrete is set. Under long spans a center line of supports must be maintained for at least three weeks after the concrete has been poured. In cold weather the contractor must leave the forms in place until directed by the architect to remove them, and no concrete shall be poured when the temperature is below freezing unless provision is made for the heating and protection of the work.

STANDARD FLAT ARCH COMBINATION

END AND SIDE CONSTRUCTION

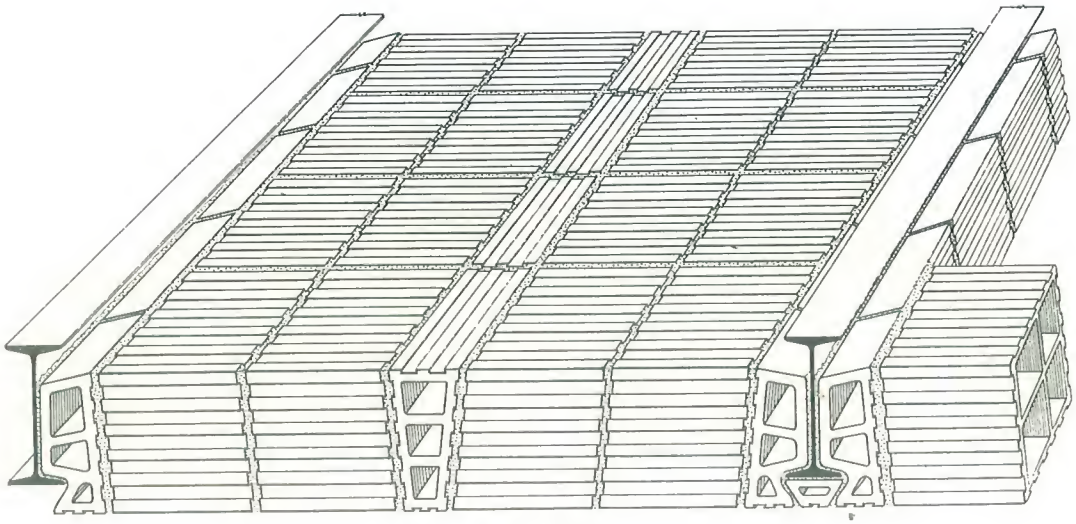


Fig. 1035

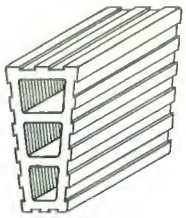


Fig. 1029-F

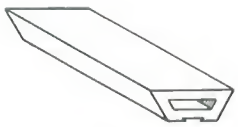


Fig. 1052-A

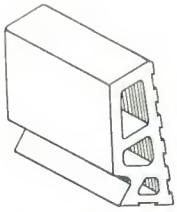


Fig. 1029-D

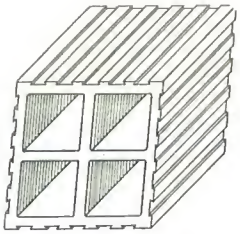


Fig. 1029-E

We recommend the use of heavy side construction skews and keys with the end construction lengtheners as shown above for most purposes. By reversing the direction of the cells in the skews, better protection is given to the sides of the beams by the mortar joints and by the shells of the skews.

The "lengtheners" must be set end to end in straight courses from skew to key. The typical section shown above illustrates the method of assembling the various members of the arch.

The depth of the arch must be proportioned to the span between the beams and to a certain extent to the load to be carried. Safe loads for various spans are given in the table and example on page 80 for both types of flat arch construction.

The line of greatest pressure in a flat arch is near the top of the key and the bottom of the skewback. Skewbacks should have inclined web member as shown to oppose the thrust near the bottom. This is of the utmost importance in order to develop the full strength of the arch.

Where a paneled ceiling effect can be permitted, the dead weight of cinder fill over the arches can be frequently reduced by using raised skewbacks, thus raising the top of the arch level with or above the top of the beams. This is not sound fireproof construction and is not recommended.

LIGHT WEIGHT FLAT ARCH

END CONSTRUCTION

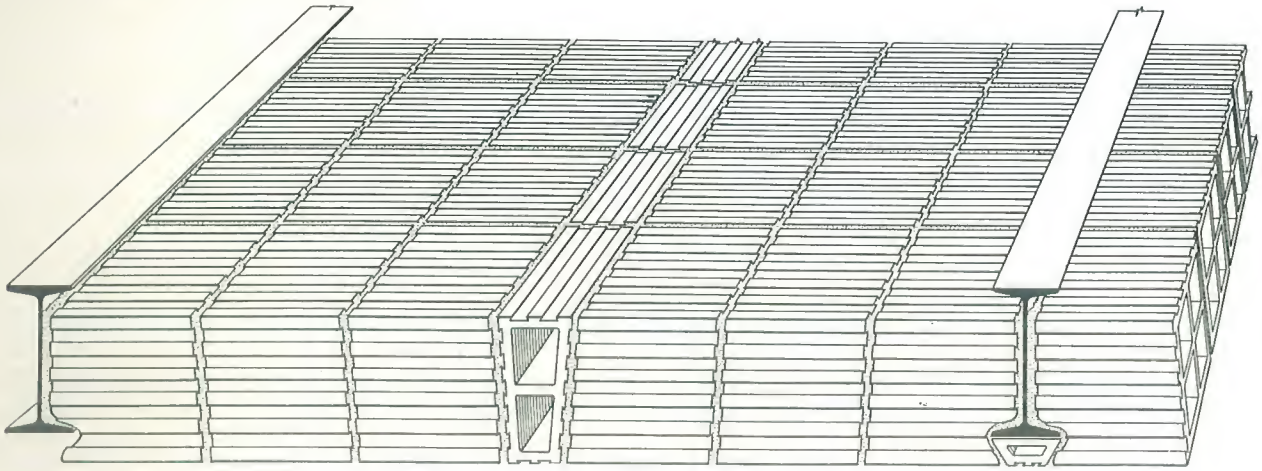


Fig. 1037

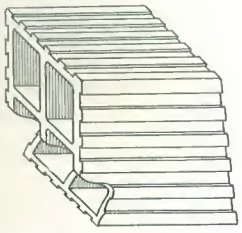


Fig. 1037-B

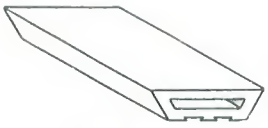


Fig. 1052

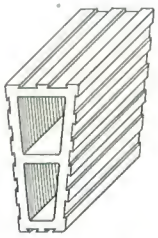


Fig. 1037-C

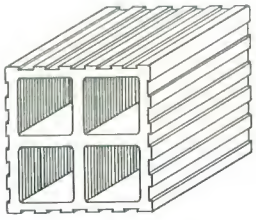


Fig. 1037-D

Flat arches as adapted to floors and roofs are made up of various shaped tile, as shown in the drawing above.

The tile resting against the beams are called "skews" and the protection for the under side of the beam is known as the "soffit" tile which is held in place by the bevel on the "skews." The intermediate tile are called "lengtheners," and the center one the "key."

There is shown above a typical section illustrating the method of assembling the various members of the arch. The depth of the arch must be proportioned to the span between the beams and to a certain extent to the load to be carried. Safe loads for various spans are given in the table on page 80.

A safe general rule for finding the proper depth of the arch in inches is to multiply the span by 1½ inches, and add the thickness of the protection below the beams. This is the requirement of the New York code. Outside shells and interior webs should be not less than ⅝-inch and ½-inch thick, respectively, and all exposed beams covered by at least one and one-half inches of hollow tile.

The arch tile must be set end to end in straight courses from beam to beam, except for the keys which are usually side construction as shown above. The tile are cut to a proper bevel and the tighter they are set the stronger the arch.

If a wood floor is built over the arches the space between the tile arch and the wood flooring should be completely filled with concrete, made of broken tile or cinders, sand and cement as shown in typical sections on page 81. Under no circumstances should this space be left open for the free circulation of fire.

FLAT ARCH DATA FOR DESIGNING PURPOSES

The following table is applicable to most all shapes of tile. Generally speaking, hollow tile of various shapes but of the same depth and cross-sectional area properly disposed, have equal strength and, therefore, the strength of arches of equal depth, is directly proportional to their cross-sectional area or weights.

Example: What load will an 8-inch arch carry with a factor of safety of 5 in a span of 5 feet 6 inches, the arch having a weight of 36 lbs. per square foot? In the table, 8-inch arch has a strength of 228 lbs. for a weight of 32 lbs. Therefore, 32:36:: 228:256 and $256 \times 7 - 5 = 358$ lbs. total load. $358 - 36$ lbs. dead load $= 322$ lbs. live load, which must be further reduced by the weight of fill over the arch, finish flooring and plastering to get the net safe live load. The weight of partitions, unless they come over beams and girders, should be considered as an addition to either the dead load or be considered in fixing the live load allowed for.

The weight of the arch has **not** been deducted from safe loads in table below; therefore, this and all other dead loads must be deducted to obtain the net safe live load for any arch and span.

TABLE OF SAFE LOADS (DEAD AND LIVE)

Factor of safety of 7 based on the ultimate crushing strength of the tile, which in practice with cement mortar joints works out to about 4 or 5.

Arches	6 Inches	7 Inches	8 Inches	9 Inches	10 Inches	12 Inches	15 Inches
Average Weight per Sq. Ft.	26	29	32	35	38	42	50
Spans Feet and Inches	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
3–0	482	617	767	933	1114	1524	2255
3–3	410	525	654	795	950	1299	1922
3–6	354	453	563	685	819	1120	1657
3–9	308	394	491	597	713	975	1443
4–0	271	347	431	525	627	857	1268
4–3	240	307	382	465	555	759	1124
4–6	214	274	341	414	495	677	1002
4–9	192	246	306	372	444	608	900
5–0	173	222	276	336	401	548	812
5–3	...	201	250	304	364	497	736
5–6	...	183	228	277	331	453	671
5–9	...	168	208	254	303	415	614
6–0	...	...	191	233	278	381	563
6–3	...	...	176	215	256	351	519
6–6	...	...	163	198	237	324	480
6–9	...	...	...	184	220	301	445
7–0	...	...	...	171	204	280	414
7–6	...	...	...	...	178	243	360
8–0	...	...	...	...	...	214	317
8–6	...	...	...	...	...	190	281
9–0	...	...	...	...	...	169	250
9–6	...	...	...	...	...	...	225
10–0	...	...	...	...	...	...	203

DETAIL OF FLAT ARCHES
FLUSH AND PANELLED CEILINGS

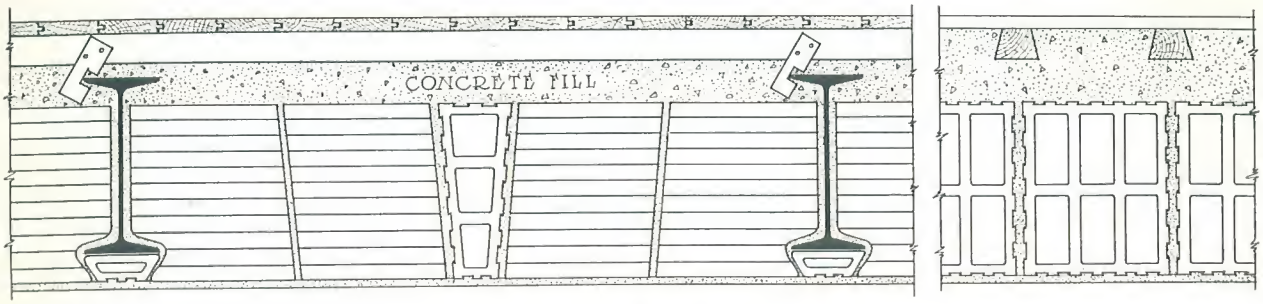


Fig. 1029

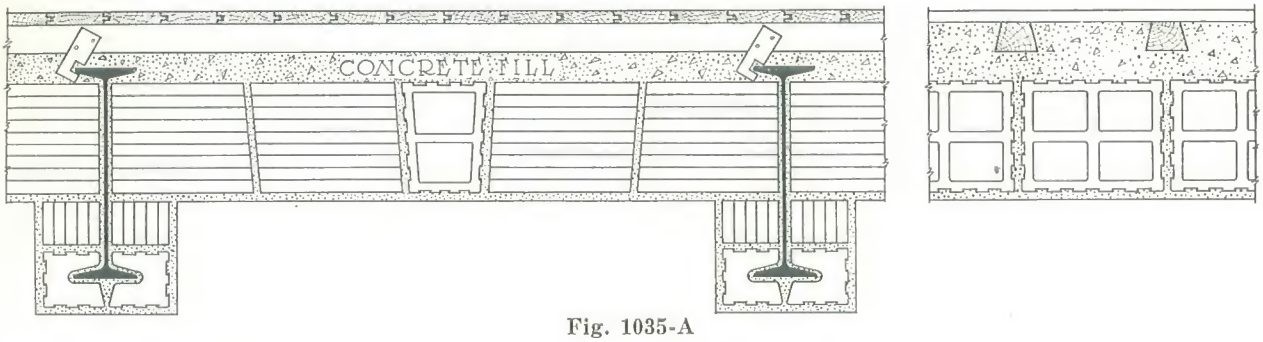


Fig. 1035-A

CENTERING OR FALSE WORK
FLAT AND SEGMENTAL ARCHES

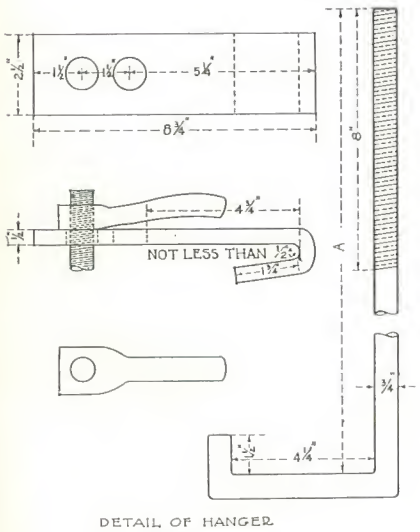


Fig. 1014

Figs. 1044 and 1044-A on page 82 suggests methods of hanging false work from the floor beams for the erection of Hollow Tile flat arches. Fig. 1013 shows large detail of double hanger for supporting the stringers and planks upon which the Hollow Tile arches are built. By increasing or decreasing the length of the hangers or the thickness of the blocks over the "I" beams the several thicknesses of floor arches may be accommodated.

Fig. 1039 on page 82 shows method of hanging segmental arch centering without the use of top stringers as described in Figs. 1044 and 1044-A on page 82. Fig. 1014 shows detail of hanger and wrench for supporting the false work upon the steel framing.

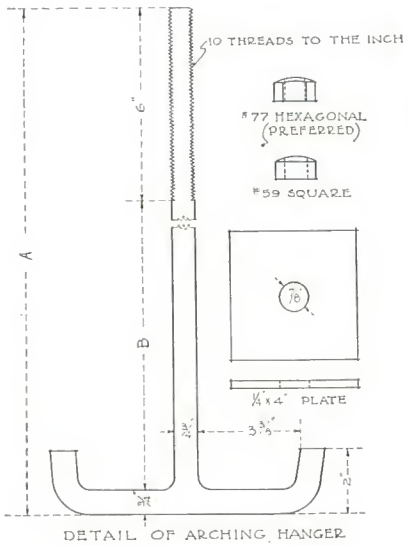


Fig. 1013

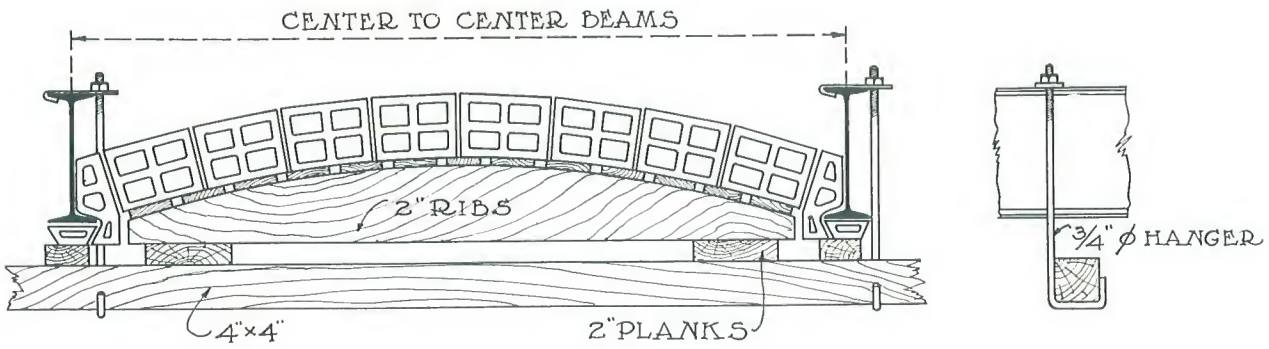


Fig. 1039

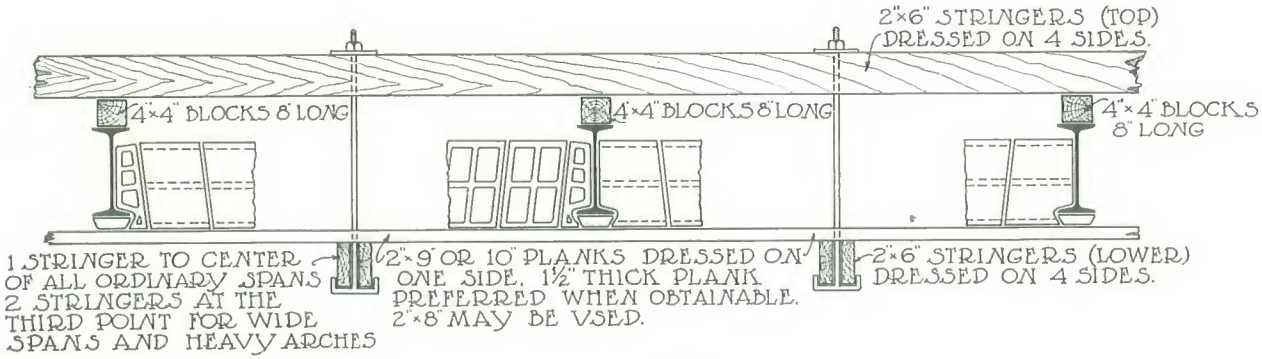


Fig. 1044-A

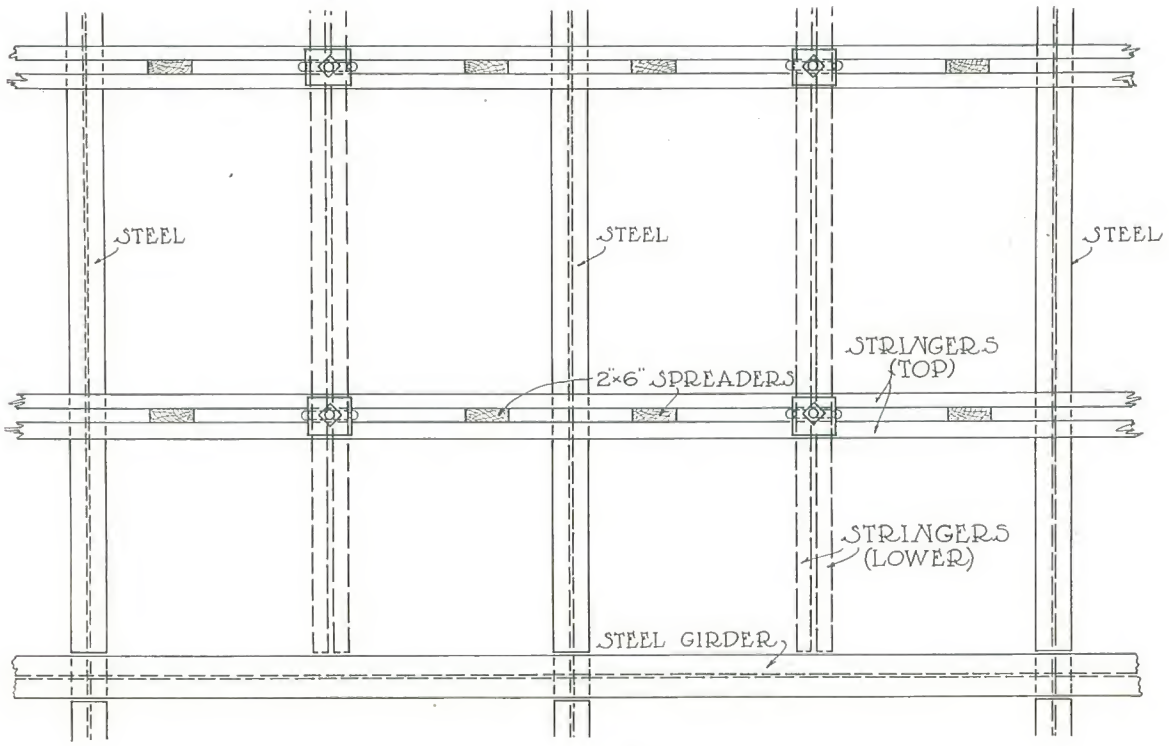


Fig. 1044

SEGMENTAL ARCH

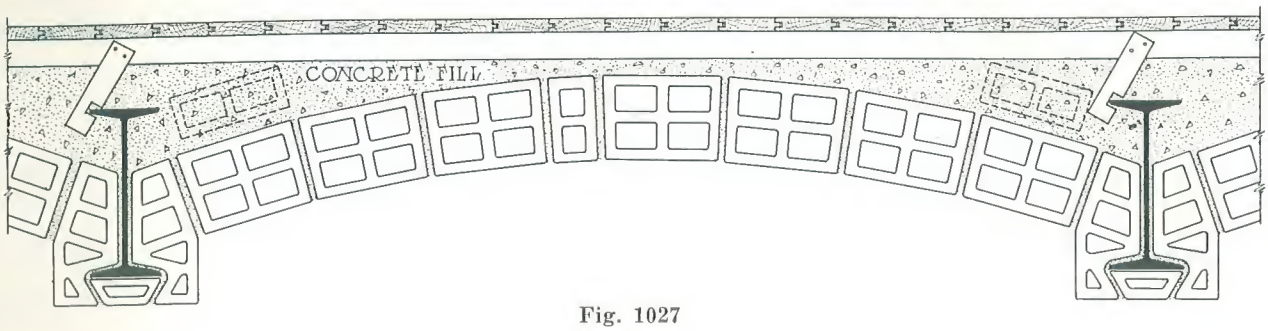


Fig. 1027

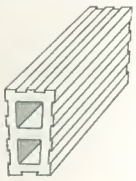


Fig. 1027-C

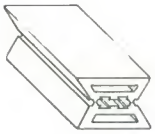


Fig. 1037-A
As manufactured

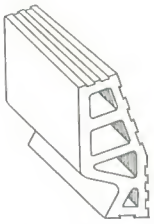


Fig. 1027-A

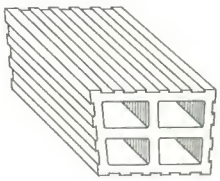


Fig. 1027-B

This form of arch is the strongest and cheapest possible. It is particularly adaptable to warehouses, lofts, factories, sidewalks, or wherever great strength is required and a flat ceiling is not necessary.

The 6-inch arch is generally used, and is as strong, for all ordinary purposes, as the 8-inch of equal rise and thickness of shells and webs. Segmental arches should always be set with the lengthener blocks breaking joints in the voussoir courses.

End construction tile may be used, but they are unsatisfactory unless the arches are of uniform span and rise throughout and are generally not recommended. Dotted lines indicate Tile Haunch Filler that is often used to reduce dead weight.

Where a very light, strong arch is required in deep beams, and a flat ceiling is also demanded, this result can be obtained by using a metal lath ceiling.

The most effective location for the tie rods to counteract the thrust is near the bottom of the beams. They may be placed there and painted, or set higher and protected by the arch. If this is done the rods in the end spans should be made forked or double rods set crossing each other. The table on page 84 gives the strength of various thicknesses of arches for different spans and rise.

SAFE LOADS—SEGMENTAL ARCH

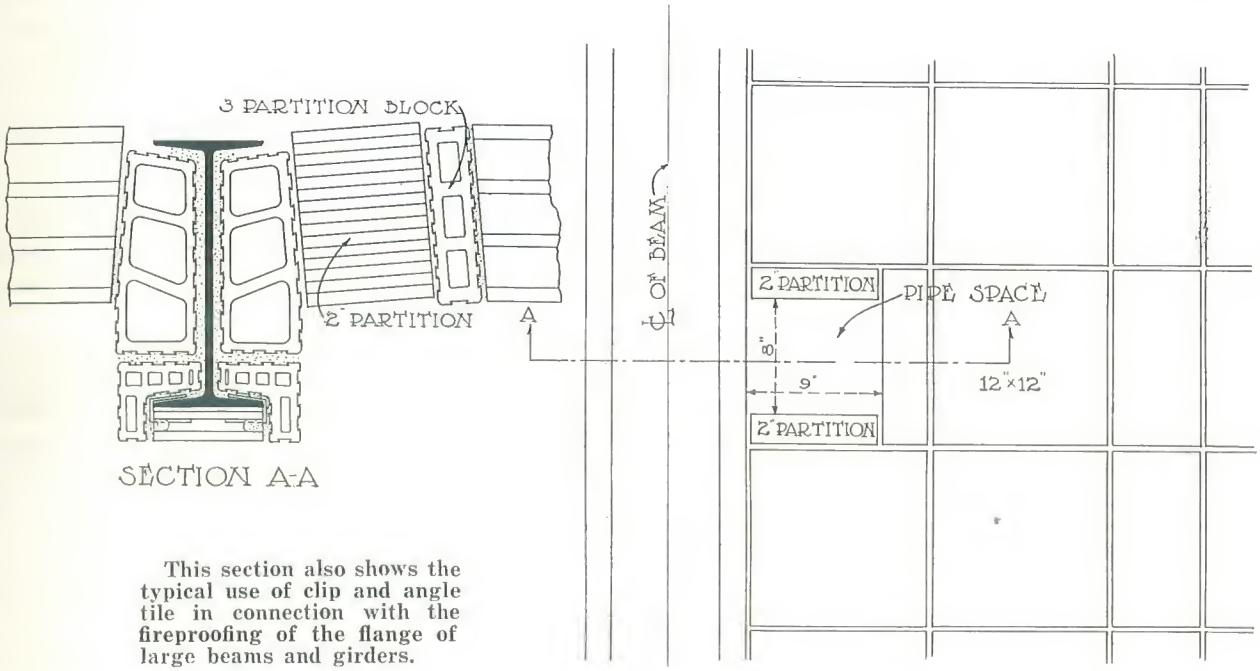
Given for tile with the following sectional areas (per foot of arch parallel with beams): 5-inch arch, 28 square inches; 6-inch, 36 square inches; 8-inch, 43 square inches; 10-inch, 47 square inches. Factor of safety, 7, based on ultimate crushing strength of tile.

Rise in inches per foot of span. Example: Rise 1½ for 12 ft. span=18 inches.

NOTE—The weight of the arch tile has been deducted in table so that only the dead load of concrete fill, plastering, etc., must be deducted to obtain net live load.

Spans Feet & Inches	Rise, Inches	6-inch Arch Lbs.	8-inch Arch Lbs.	10-inch Arch Lbs.	Spans Feet & Inches	Rise, Inches	6-inch Arch Lbs.	8-inch Arch Lbs.	10-inch Arch Lbs.	Spans Feet & Inches	Rise, Inches	6-inch Arch Lbs.	8-inch Arch Lbs.	10-inch Arch Lbs.
	¾	902	1078	1178		¾	411	491	536		¾	261	312	341
	1	1184	1414	1545		1	551	658	719		1	351	419	458
4	1¼	1485	1774	1939	8–6	1¼	678	810	885	13	1¼	437	522	570
	1½	1740	2079	2272		1½	806	963	1052		1½	519	620	677
	1¾	1986	2373	2593		1¾	926	1106	1208		1¾	596	712	778
	2	2233	2667	2915		2	1037	1239	1354		2	670	801	875
	¾	792	946	1034		¾	386	461	504		¾	240	287	313
	1	1044	1247	1363		1	518	619	677		1	326	390	426
4–6	1¼	1313	1568	1713	9	1¼	645	770	842	14	1¼	406	485	530
	1½	1539	1838	2009		1½	758	906	990		1½	482	575	629
	1¾	1775	2121	2318		1¾	871	1041	1137		1¾	553	661	722
	2	1975	2359	2578		2	977	1167	1275		2	619	740	808
	¾	709	847	926		¾	364	435	475		¾	225	268	293
	1	957	1143	1249		1	489	584	638		1	302	361	394
5	1¼	1172	1400	1530	9–6	1¼	608	726	793	15	1¼	377	450	491
	1½	1379	1647	1800		1½	721	862	942		1½	447	534	583
	1¾	1592	1902	2078		1¾	823	983	1074		1¾	515	616	673
	2	1773	2118	2315		2	923	1102	1204		2	577	690	754
	¾	641	766	837		¾	344	411	449		¾	209	249	272
	1	864	1032	1128		1	462	552	603		1	281	336	367
5–6	1¼	1062	1269	1387	10	1¼	576	688	751	16	1¼	353	421	460
	1½	1266	1512	1652		1½	683	816	892		1½	419	500	546
	1¾	1439	1719	1879		1¾	784	937	1024		1¾	481	575	628
	2	1619	1933	2113		2	879	1050	1147		2	540	645	705
	¾	585	699	764		¾	331	396	432		¾	194	232	254
	1	788	941	1028		1	438	523	572		1	265	316	345
6	1¼	969	1157	1265	10–6	1¼	546	652	713	17	1¼	330	394	430
	1½	1154	1379	1507		1½	648	774	846		1½	392	468	512
	1¾	1315	1570	1716		1¾	744	889	972		1¾	452	540	590
	2	1476	1763	1927		2	832	994	1086		2	506	605	661
	¾	551	658	719		¾	315	376	411		¾	182	218	238
	1	724	864	944		1	421	503	550		1	248	296	324
6–6	1¼	902	1077	1177	11	1¼	519	621	678	18	1¼	310	370	404
	1½	1058	1264	1382		1½	617	737	805		1½	370	442	482
	1¾	1218	1455	1590		1¾	709	847	925		1¾	425	507	554
	2	1358	1622	1772		2	794	948	1036		2	477	570	623
	¾	508	606	662		¾	299	358	391		¾	173	206	225
	1	669	799	873		1	401	480	524		1	233	279	304
7	1¼	834	996	1089	11–6	1¼	499	596	652	19	1¼	293	350	382
	1½	981	1171	1280		1½	592	707	773		1½	348	416	455
	1¾	1127	1346	1471		1¾	680	812	887		1¾	402	480	524
	2	1264	1510	1650		2	761	909	993		2	451	539	589
	¾	471	563	615		¾	285	341	372		¾	163	194	212
	1	621	741	810		1	383	458	500		1	221	265	289
7–6	1¼	774	925	1011	12	1¼	477	569	622	20	1¼	277	331	361
	1½	920	1099	1201		1½	566	676	738		1½	330	395	431
	1¾	1049	1253	1369		1¾	649	776	848		1¾	381	455	497
	2	1176	1405	1536		2	727	869	949		2	427	510	558
	¾	439	525	573		¾	273	326	356		¾	153	183	200
	1	588	703	768		1	366	437	478		1	209	250	273
8	1¼	724	864	944	12–6	1¼	456	545	595	21	1¼	263	315	344
	1½	859	1026	1122		1½	541	646	706		1½	314	375	409
	1¾	987	1179	1288		1¾	621	742	811		1¾	361	432	472
	2	1099	1312	1434		2	696	832	909		2	406	485	530

OPENINGS IN FLAT ARCH



This section also shows the typical use of clip and angle tile in connection with the fireproofing of the flange of large beams and girders.

Fig. 1046

TYPICAL SPANDREL SECTIONS

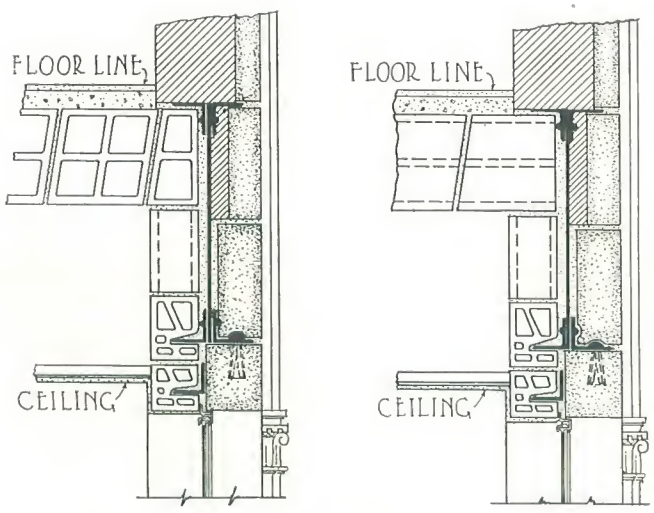


Fig. 1045

GIRDER COVERINGS

The problem of fireproofing the wide flange girder beam is one that can best be solved by the use of Hollow Tile.

The proper fireproofing of these beams is a very important matter, as they generally carry heavy loads, on wide spans, or carry important wall and column loads, where they replace built up sections such as plate or box girders. Encasing these beams with concrete, even in connection with the solid reinforced concrete slabs or combination Hollow Tile and concrete floor construction, is not economical both on account of the extra dead weight that is added and the expensive form and false work necessary. The ordinary clip or shoe tile that is used on the smaller beams is not generally considered satisfactory because of the great difficulty in producing satisfactory tile shapes with bottom lugs long enough to cover these steel sections.

TABLE OF LENGTHS FOR SQUARE EDGE SOFFITS OF 2x12 OR 3x12 TILE

Size Beam	Designation	Weight Beam	Width Flange	Length of Soffit Tile
15″	I Beam	42 lbs.	5.5″	5½″
18″	I "	55 "	6″	6 "
20″	I "	65 "	6.25″	6¾″
24″	I "	80 "	7.0 "	7½″
10″	Beth. I	23.5 "	5.85″	6 "
12″	" I	28.5 "	6.12″	6 "
15″	" I	38 "	6.66″	6¾″
18″	" I	48.5 "	7.5 "	7½″
20″	" I	59 "	8.0 "	8¼″
24″	" I	73 "	9.0 "	9 "
10″	Beth. Girder	44 "	9.0 "	9 "
12″	" "	55 "	9.75″	10 "
15″	" "	73 "	10.5 "	11 "
18″	" "	92 "	11.6 "	12 "
20″	" "	112 "	12. "	12 "
24″	" "	120 "	12. "	12 "

The proper way to cover such steel sections is with clamp and "L" or angle tile as shown by Fig. 1032-D on page 88. This method may be used for standard "I" beams 15″ and larger in depth. The same scheme of covering applies to a plate girder as shown by Fig. 1032 on page 88. There are no rolled sections and very few built up sections that would be used in building construction that cannot be thoroughly fireproofed in this manner.

The soffit covering or clamp tile is formed of a thick shelled 2″ partition (2″x12″ section) cut to the lengths required by the several widths of flange as given in table herewith. The smaller size "I" beams are best covered with the clip tile shapes, which may be used on all standard "I" beams and on Bethlehem "I" beams up to 15″ deep. This method of flange covering, except on the smaller beams, is not as satisfactory as the clamp and "L" tile covering.

For the plate or box girders having flanges over 14″ in width the soffit piece may be made of 3″x12″ standard thick shelled column covering.

The 2″ thick soffit covering may be used up to 15″ or 16″ widths but is very difficult to manufacture owing to the tendency to warp and except in special instances it is therefore best to use the 3″ thick soffit covering on flanges of greater width than 14″.

The method of applying this form of fireproofing to the steel is such that the angle tile is always thoroughly bedded on the flange and can be used to support slabs of long span and quite heavy floor loads.

Furthermore in pushing this piece into place a cement mortar key is formed into the cells of the soffit piece, securely keying same into place throughout the length of beam entirely independent of the band iron clips. For the "U" shape clips No. 18 or No. 19 gauge band iron ⅞″ or 1″ in width should be used for the average width of flange and No. 16 gauge for the larger beams and built up sections. For the smaller sizes of soffit one clip on each side placed at diagonally opposite corners may be used, and four clips for the large sizes. Heavy iron wire extending through the cells of tile and bent up over flange has sometimes been used but is not as satisfactory as "U" clips.

The web covering may be either single or double thickness of tile, and for all important beams should extend up to the underside of the top flange so as to encase the beams or girder independent of the floor arch construction. When concrete slabs or long span floors are used this web covering should extend to the underside of the slab. For deep, wide girders the web covering should be double thickness with joints between tile broken as shown by Fig. 1042 on page 88. Girders

can be thoroughly fireproofing in this manner with a minimum of dead weight and at considerable less cost than for concrete covering.

When it is desired to use concrete covering on the flanges of truss and box girder members having a series of cover plates of considerable and varying thickness and on which the tile covering may not be considered suitable, the webs should be covered with Hollow Tile in the same manner as shown by Fig. 1032 on page 88 for plate girders and the flange members only encased with concrete as shown by Fig. 1042 on page 88.

In connection with Hollow Tile arch floor construction, and even with many systems of reinforced concrete or combined reinforced concrete and Hollow Tile floor construction on steel frame construction, the fireproof covering of the beams and girders can best be effectively protected with Hollow Tile set in cement mortar.

On large girders the saving in dead weight by substituting tile for solid concrete covering may amount to 50% or more, and anyone who is skeptical as to the fire protection afforded by 1″ or 2″ of Hollow Tile should refer to the records of conflagration, particularly the Baltimore fire, which show that the damage to structural steel in the Calvert Building was 1.37% and in the Union Trust Building 1.03%, both representative of tile fireproof structures.

Taking advantage of the lessons learned in this and other great fires and by proper methods of setting the tile, even such damage may be eliminated. Hollow Tile when used for beam and girder covering should be solidly bedded against the steel with a full bed of cement mortar.

TILE SHAPES FOR GIRDER COVERING

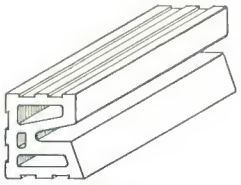


Fig. 1029-A

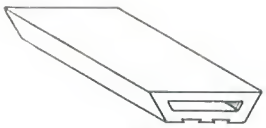


Fig. 1052

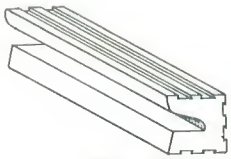


Fig. 1029-C

It is essential that all girders projecting below the ceiling be protected by at least 1½ inches of hollow tile. Those girders which are framed level with the floor beams may be covered with the same thickness of hollow tile as used to cover the beams. If heavy plaster cornices are used the girders are protected against fire by the hollow tile, and the shape required for the plastering is obtained by iron brackets and metal lath, but this latter is not sufficient protection alone.

The lower flange of the I beam is usually covered by "clip tiles" and the web by partition tiles as shown on page 88. Where double I beams are used the soffits are covered by a clamp and "L" tile. Also, for plate girders and where the space is wide the soffit should be hung on metal clips, which are protected, as shown in Fig. 1032 on page 88.

The girder covering may be set when the arches are installed or later. If set with the arches, the partition tile which rests upon the clip tile or clamp and "L" tile is held in place by the arch. If set later the space between the clip tile or clamp and "L" tile and the bottom of the arch is filled by a short tile or hollow brick. The two methods are clearly shown on page 88.

Channel beams should never be used except against brick walls, as it is almost impossible to properly protect them at less expense than the cost of the I-beams.

The covering of all important girders should be specified to be independent of the arching as shown in Fig. 1033 on page 88 and all girder covering to be applied with a full bed of cement mortar against the steel beam.

The metal clamps shown are only required to hold the soffit piece in place during erection, after which it is securely held in place by the cement mortar key.

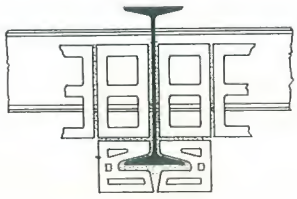


Fig. 1032-A

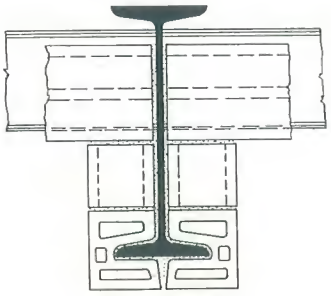


Fig. 1032-B

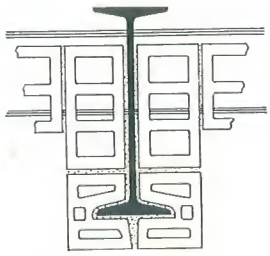


Fig. 1032-C

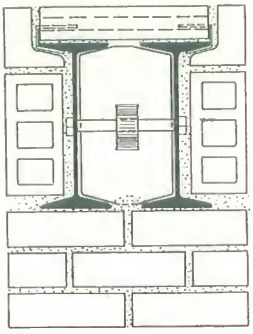


Fig. 1032-D

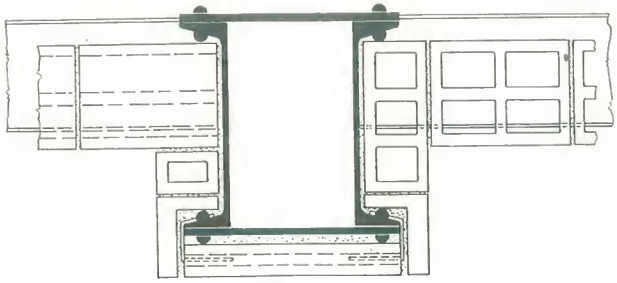


Fig. 1032

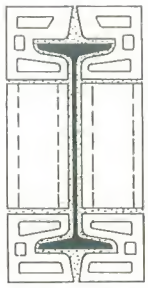


Fig. 1032-E

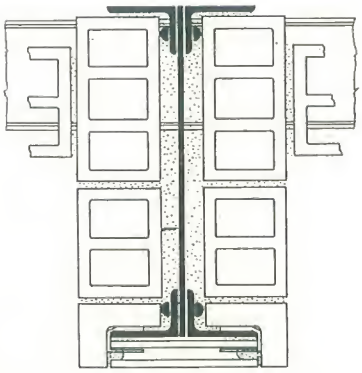


Fig. 1033

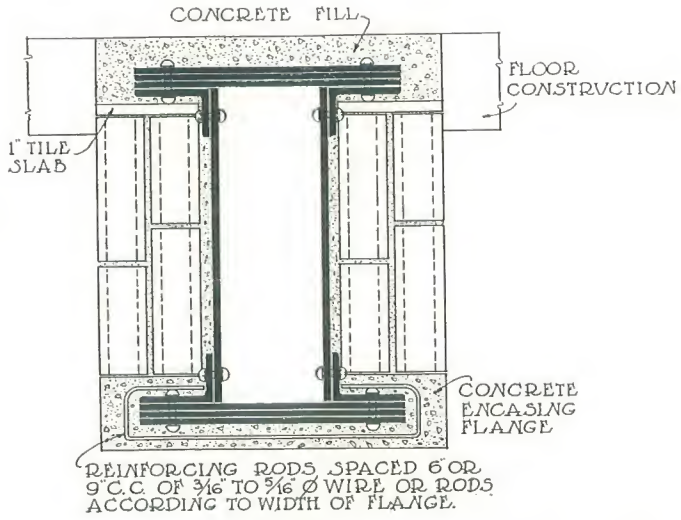


Fig. 1042

COLUMN FIREPROOFING

The proper fireproof covering and protection of steel columns in skeleton structures and in fact all vertical or cast iron members supporting wall or floor loads is an item of the greatest importance and one that in the past has not received the careful consideration that it deserves.

Frequently the necessity for enclosing pipes and conduits without increasing the finished sizes of columns or piers has led to violations of proper column fireproofing and the trouble caused by this is largely responsible for the very stringent Building Code requirements that now exist in many cities.

Where any question exists as to the proper fireproofing of columns and the preservation of their carrying capacity against the ravage of both fire and the elements for an indefinite period, a low rate of fire insurance cannot be obtained and certainly is not justified.

Experience has clearly demonstrated the superiority of burned clay products for this purpose.

In steel skeleton frame structures where Hollow Building Tile is used for the walls, either as a backing for face brick or sawed stone or where used alone or with stucco finish, the wall columns should be encased and protected by carrying the Hollow Tile wall around the steel columns that occur along the walls in the form of piers, solidly encasing the steel with a minimum thickness of 3″ and securely anchoring the enclosing walls to the structural frame.

The channel spaces in columns should first be filled with proper size of tile filler, bedded solidly against the steel with full bed of Portland cement mortar. Hollow Tile for this purpose can readily be selected from the various standard partition, wall or building tile shapes. The filled columns should then be plastered with Portland cement mortar as the walls are carried up a couple of feet in advance of the setting of the tile that encase the columns. With Hollow Tile covering this cement plastering of the steel is preferable to the grouting method used with brick covering, which it replaces. Fig. 1041-C on page 91 shows a standard column (approximately 12½x12½ either of Bethlehem or Plate and Angle section) encased with tile.

For fireproofing of interior columns in any building having steel or cast-iron columns, Hollow Tile has been proven to be the most satisfactory and dependable material and is almost universally used. It, however, is not always properly used for this very important purpose and certain basic rules are frequently violated. In the first place, the ordinary thin shelled partition tile should not be used for column protection. The fact that these tile are fireproof and suitable for partition work does not make them suitable for column fireproofing, as when built around a column, new factors are introduced and the sudden expansion of the thin outer shell of these tile in a hot flash fire may result in the shearing off of same before it has the opportunity of rendering its required service in effectively resisting the action of flame and transmission of heat to the encased steel.

Therefore, only the regular thick column covering tile or a thick shelled porous or semi-porous partition tile should be used. The column covering must not be built on an accumulation of several inches of mortar droppings and scraps of brick and lime mortar, that generally collect and adhere to the rough fireproof floor construction during erection, nor should it be built on top of cinder concrete fill. Column covering should start from the fireproof floor construction scraped clean and where differences of level occur between the tops of beams and top of floor construction a level bed for the starting of lower course of column covering should be formed by filling in the low space around column with slabs of broken tile bedded in Portland cement mortar, also the covering should be built tight against fireproof ceiling above, with a full mortar joint but without wedging of tile, slate or other material which is specified for partitions and sometimes in error also specified for column covering. Solid mortar contact between the tile column covering and the cement plastering on steel column is not particularly desired and the older method of filling the

channel space with concrete as the covering was erected, is not as satisfactory and effective, nor as economical, as the Hollow Tile filling which is here recommended.

All interior column covering should be bound twice to each course of tile with a No. 10 iron wire, or have "U" shaped clips of No. 16 strap iron slipped down over the abutting shells of all blocks in every course as they are erected. The cost of these clips or the wires is but a slight addition to cost of column fireproofing and on the cost of entire fireproofing is negligible.

All piping, conduits, and ducts should be placed outside of the column fireproofing in a separate chase or flue, built alongside of the fireproofed column, for this purpose and as these pipe enclosures interfere with proper bonding of column covering and further cannot be built till after the piping is installed and tested, it is usually best to tie same to the column covering with metal ties built in for that purpose, rather than attempt to secure a masonry bond with the column protection. Unless the latter can be built troughed out for a later bonding of the pipe enclosure.

Where space is limited a 2″ thick tile or even a metal lath may be used for the enclosing of pipes and ducts alongside of columns. Architects should always insist that the columns be properly fireproofed independent of duct covering, furring or other enclosures. It is permissible and often desirable to bond in the main partition or division walls and stair or elevator wall enclosures, with the covering of columns but no sub-dividing partitions should be built or bonded into column covering. Such partitions should be anchored to columns with metal ties, built in for that purpose or by hooks of band iron that may be put in later by cutting into mortar joint where required. See pages 90 and 91 for detail of interior column fire-proofing, which shows the methods of covering, both where columns are isolated and bonded to partition walls and where pipe enclosures occur.

For all ordinary requirements either the 3″ or 4″ thick column covering tile may be used; except where building code restrictions call for a minimum 4″ thickness of hollow tile; either being about equally as effective fireproofing; the story height and architectural preference being the determining factor, and in certain cases, where space is limited and story height moderate, even a 2″ Hollow Tile may be used, providing a thick shelled, hollow or solid porous block is used, in fact, for round cast-iron columns it is both satisfactory and customary to use a 2″ thick solid porous covering.

For all special requirements such as in buildings where the fire hazard is great and for important columns that carry very heavy truss, wall or girder loads, we recommend a 4″ covering or a double covering of 2″ thick Hollow Tile.

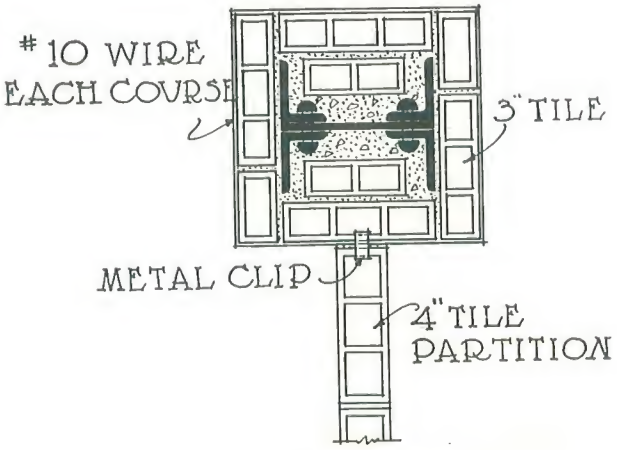


Fig. 1041-A

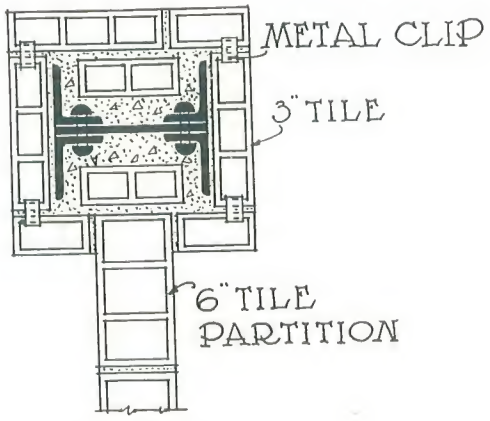


Fig. 1041-B

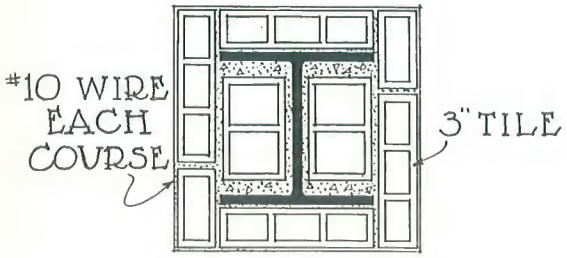


Fig. 1041-C

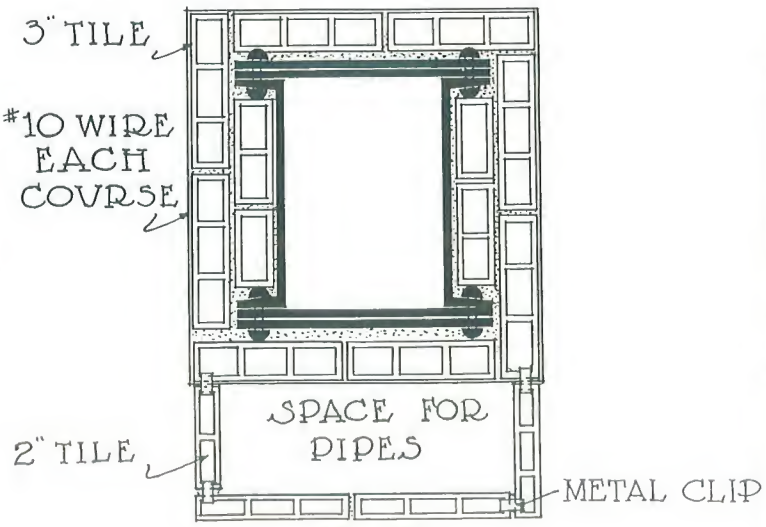


Fig. 1041

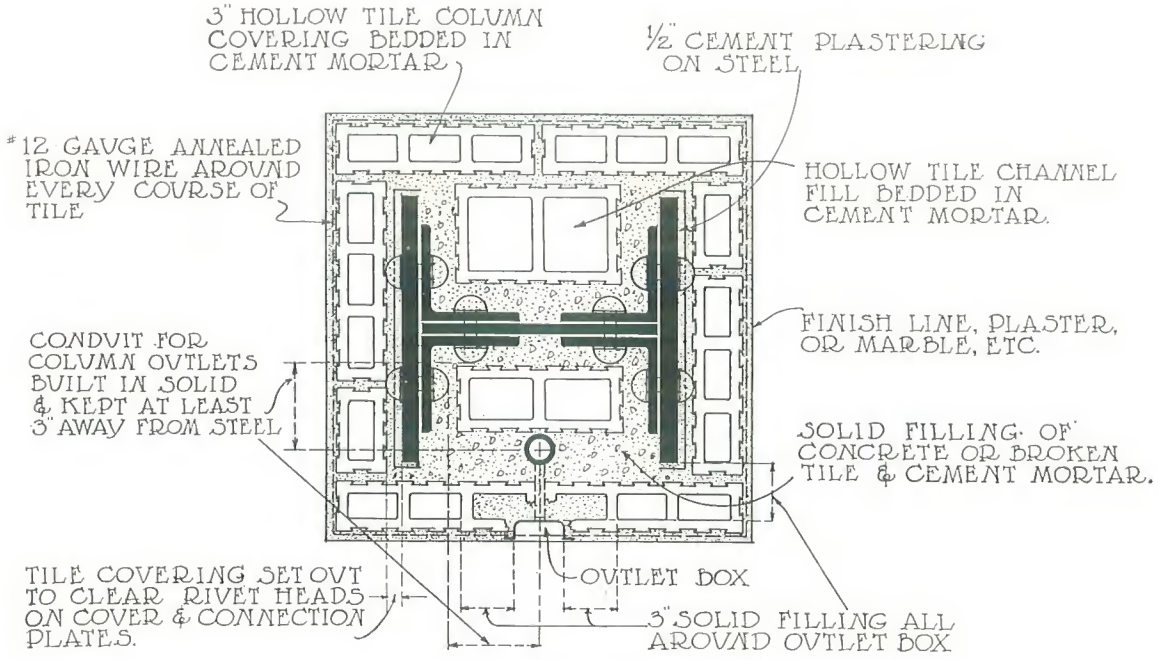


Fig. 1040

Fig. 1041-A on page 90 shows method of building sub-dividing partitions in connection with interior columns. Fig. 1041-B on page 90 shows method of bonding in the main partition or division walls and stair or elevator wall enclosures with the column fireproofing. In Fig. 1041-C a Bethlehem shape is shown encased in Hollow Tile fireproofing. Fig. 1041 shows the arrangements and method of building separate pipe chases alongside of columns. Care must be used to fireproof the steel column independent of the pipe space. Fig. 1040 shows the permissible placing of one conduit and outlet box in interior column fireproofing providing at least 3″ of solid material surrounds this conduit and outlet box. This form of construction is **not** recommended.

WALL FURRING TILE

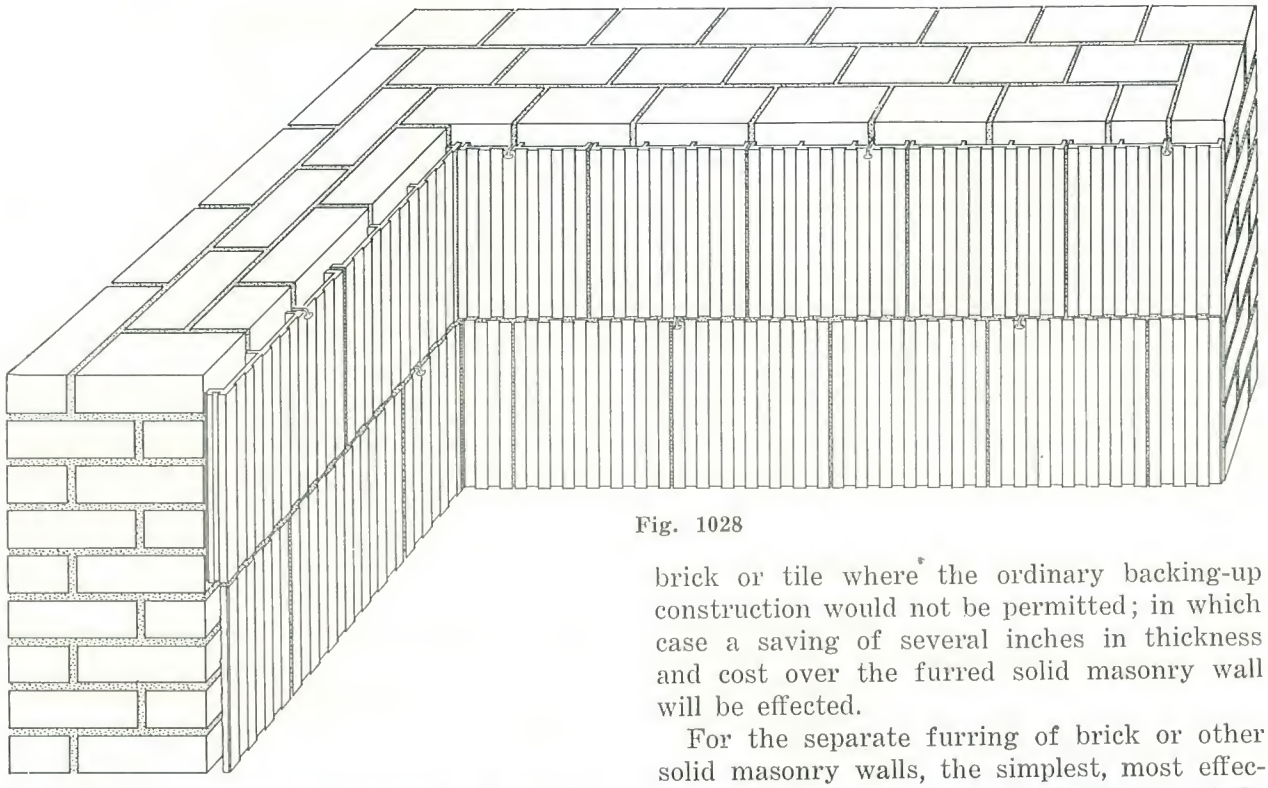


Fig. 1028

Most solid masonry walls must be furred to prevent dampness from reaching the interior by capillary attraction and destroying the plastering or interior finish of the building. Furring is usually advisable as it greatly increases the insulating value of any wall whether built of brick, tile, stone, concrete, or other material. Furring is not needed with walls of Hollow Tile. This may seem peculiar to some but the fact remains that such walls have proved dry and entirely satisfactory, which is doubtless accounted for by several factors; the great density of the tile, the smaller quantity of solid material and mortar in wall, the higher grade mortar generally used and the dead air spaces contained within the tile. Furring, however, will increase the insulation efficiency of a tile wall on the same principle that by an increase in the thickness of wall and number of cells the insulating value is increased.

Integral furring has particular merit for special purposes and should be used where building codes are so written that only the inner 4″ of a bearing wall may be of hollow brick or tile where the ordinary backing-up construction would not be permitted; in which case a saving of several inches in thickness and cost over the furred solid masonry wall will be effected.

For the separate furring of brick or other solid masonry walls, the simplest, most effective and cheapest form of furring is of 2″ thick furring tile, which are split from a block similar to the 4″ partition tile.

This type of furring which is shown on page 12 should be built against the brick wall without mortar on back of the ribs to avoid a solid contact, the tile being fastened to wall by driving 10 penny nails into the mortar joints of brickwork and bending the head of nail down over the tile, one nail to about every third tile in every second course.

Where a cement or rich cement lime mortar has been used for laying up the brickwork, it will be found somewhat difficult to drive ordinary nails into the joints and a heavy short nail, with thin metal washer may have to be substituted, but in such instances it is much better to build heavy wire ties into the wall as brickwork is carried up; to be bent down over the tile when it is erected later.

Architects should clearly specify such items, as contractors, foremen, and superintendents are prone to neglect them.

Split furring cannot be built free standing; therefore, where the walls are of different thickness or where the interior is furred out to suit some architectural requirement, the ordinary 3″ or 4″ light weight partition tile is used, 3″ tile is suitable in most cases even when the room is of considerable height as the tile may be braced back against and be anchored to wall at intervals with cross walls of similar partition tile.

This split form of furring is also made 1½ and 3″ in thickness on order.

The dimensions and weight of furring tile is included with partition tile on page 12.

The furring around or enclosing of pipes and ducts is usually done with 3″ thick light weight partition tile, which is referred to in detail in another section on column fireproofing.

Where walls must be straightened or furred out to line with the face of piers the 2-inch tile cannot be used.

If the ceiling height is not too great use 3-inch partition tile.

If the space is greater than 3 inches the tile may be set out from the wall leaving a clear air space behind them.

They should be braced at intervals by the use of drive anchors or tile brace walls can be used without the anchors. The cost of erecting a straight free standing furring of 3-inch partition is no greater than the 2-inch furring applied to the wall.

The face of the tile is grooved so that the plastering is applied directly upon the tile.

This form of furring is the most effective, the cheapest and most durable.

INTERIOR PARTITION CONSTRUCTION

Hollow partition tile, set in cement mortar, is the generally recognized standard for all classes of partitions. In the Baltimore, Rochester and San Francisco conflagrations, Hollow Tile partitions were thoroughly tested and proved to be the only ones that could be depended on to withstand such a severe fire test. In these fires there were instances of failure in this most fireproof of fire-resistive partition construction but these cases all clearly indicated the improper use of the product. Where they were properly built upon the fireproof floor construction, wedged to the fireproof ceiling above and laid up with a good cement mortar without having wood strips built into them they stood intact.

Interior partition walls are of three types:

"A"—The Load Bearing Partition or Division Wall which is elsewhere considered. (See Load Bearing Walls.)

"B"—The Fire Wall enclosure, such as main dividing partitions which serve as fire walls and the enclosures of stair and elevator walls, pipe and stack shafts or storage vault walls.

"C"—The Ordinary Subdividing Fire-Resistive Partition, including closet and other enclosures and free standing furring.

For class "A" (Load Bearing) partitions only tile having at least three continuous webs or shells through the thickness of partition should be used. This calls ordinarily for an 8″ thickness, or for a special 6-cell 6″ tile as the minimum.

For class "B" partition it is customary to use the ordinary 6″ (or even 4″) partition tile and this is considered good practice in fireproof skeleton frame office, apartment and hotel buildings, where the story height and the lengths between column piers or other anchorages, does not exceed the dimensions given on page 95.

For class "B" partitions in other than fireproof buildings or in manufacturing and storage buildings, department stores, public garages, or any building where a greater fire hazard exists, partition tile having three continuous shells and webs should be used, which ordinarily calls for an 8″ partition, with the special 6-cell 6″ tile, as the minimum that should be used.

Class "A" and "B" partition must always be a part of the fireproof structure and should be built on the fireproof floor arch or slab construction or on properly covered steel beams and be tightly wedged up against the fireproof ceiling above.

No wood frames or bricks should be allowed in class "B" partitions, nor in class

"A" partitions when these occur in any fireproof building or where they must also act as fire walls and are so built and equipped.

In office buildings, and in certain classes of store and loft buildings of fireproof construction where the occupancy fire hazard is not great, it is permissible to build class "C" partitions on top of the finished wood floors to provide for the re-subdividing of space for tenant changes. This however, is not permitted by the building laws of New York and some other large cities, where the building codes do not permit wood floor finish and require that all doors, door frames and trim be of an incombustible material. This practically places such partitions in class "B".

All standard partition tile are grooved or scratched to receive plastering but for warehouse, factory and other rough buildings, where it is desired to omit plastering, a plain face tile may be used. This tile is not always carried in stock but will be supplied by nearly all manufacturers on order at a slight advance in cost. Such tile are referred to as smooth tile but are not intended for finished walls and while not exactly smooth, are quite suitable for unfinished walls. A coat of white wash or cold water paint may be applied.

All class "B" and certain class "C" partition should be anchored into the exterior walls and to all piers or column protection, and where partitions meet or cross they should be bonded together. For anchorage, metal ties or heavy 4" nails may be used; one of the best forms of tie is a U-shaped clip, made of 1" wide No. 16 or No. 18 gauge strap iron which can be slipped over the shells of tile as the courses are erected.

Class "C" partition should never be built or bonded into the column covering when they are built on top of wood floors, as all column fireproofing must be independent and intact from fireproof floor to fireproof ceiling above.

In banking rooms, hotel lobbies, main corridors and entrance portions of buildings having heavy marble wainscot or wall lining applied to and supported by the Hollow Tile, extra provision for anchorage should be made and sometimes it is advisable to use a thicker or heavier partition tile.

Where a long unbraced partition is desired, or for light partitions of greater height than recommended, or for partitions subjected to the constant jar from heavy swinging doors, one of the forms of woven wire reinforcing bands or approved, so-called "brick-reinforcements" that come in rolls, may be built into the mortar joints, for which purpose the tile should be laid on the side.

All class "A" and "B" partitions should be provided with lintels or flat arches, over all openings. Structural angle or "T" iron lintels may be used, but the simplest, cheapest and most satisfactory lintel is a flat arch formed of the partition tile, for which only three shapes are required to make up the arches for all sizes of openings and which the manufacturers will supply on order at slight advance in square foot cost over the straight partition tile. Such lintels may be used for all ordinary and double doors but where the openings are very wide, steel or reinforced concrete lintels should be provided for.

Lintels are not required with class "C" partition except over wide openings. Over ordinary doors, it is usual to build the straight tile on top of the wood or metal bucks.

Where wood nailing grounds must be built into subdividing partitions, they should be built in the vertical joints, never in the horizontal joints. No wood should be permitted to be built in class "B" partitions. Full porous tile nailing blocks may be specified.

The standard shapes, sizes and weights of partition tile are illustrated on page 12, which also includes furring and light weight backing up tile shapes.

The typical partition block is made as light in weight as convenient manufacturing and shipping conditions will permit. This accounts for the varying thickness of shells and webs that are to be found in partition tile of the different manufacturers, as the tile from some clays can be made lighter than others, although the thicker shell tile will usually be made of a semi-porous ware so the weight will be about the same. Such variations is not permissible with load bearing or heavy duty tile which must pass certain crushing and absorption test requirements.

HEIGHT FOR NON-BEARING PARTITIONS

The maximum allowable height for non-bearing partitions, non-bearing enclosing or panel walls, supported firmly and solidly upon a full bed at the bottom and held firmly at the top, should be as follows:

Size Tile	3″	4″	6″	8″	10″	12″
Maximum Height for Partitions	12′-0″	16′-0″	20′-0″	26′-0″	30′-0″	36′-0″
Maximum Height for Enclosing Walls	.....	.....	.....	24′-0″	30′-0″	36′-0″

PERMISSIBLE INCREASE IN HEIGHT

Non-bearing partitions, and enclosing division or panel walls, when built between rigid cross walls, piers, buttresses, pilasters or columns, and properly tied or bonded thereto, may have the heights given in the above table increased as follows:

Ratio of Length to Height of Wall	Increased Height Permitted
Length 1½ times given height	¼ of given height
Length 1 times given height	½ of given height
Length ½ times given height	¾ of given height

The thicknesses given in the table are exclusive of terra-cotta, stucco or other similar ornamental facing. Solid masonry facing may be included in the thickness provided it is bonded with full masonry headers in courses not farther apart than 25″ vertically.

TOILET ROOM FLOOR CONSTRUCTION

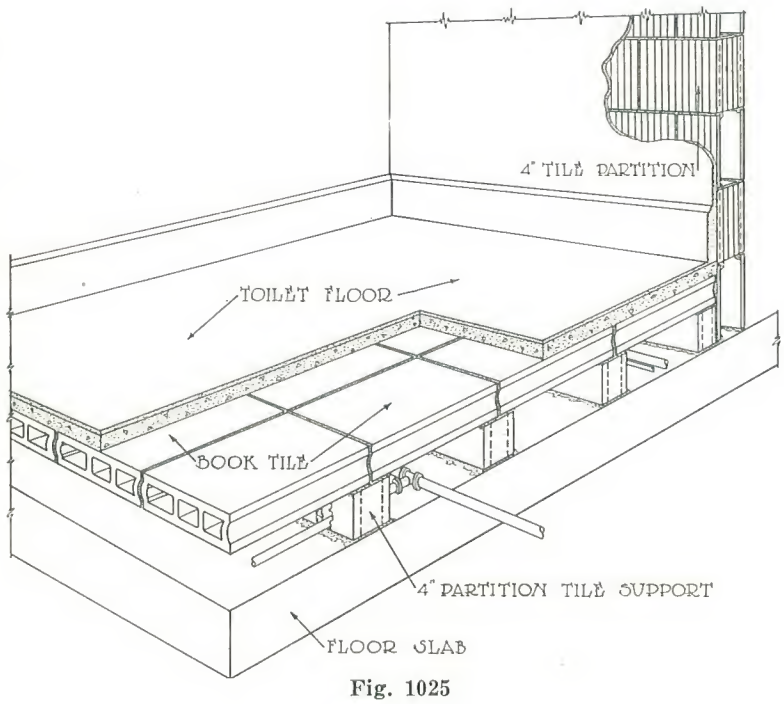


Fig. 1025

Toilet Room Floor Construction showing 4-inch Partition Tile cut in 6, 8 or 10-inch lengths, supporting ordinary partition or Book Tile on which the marble, tile, terrazzo or cement floor finish is applied on a bed of cement mortar.

TYPICAL BULKHEAD CONSTRUCTION

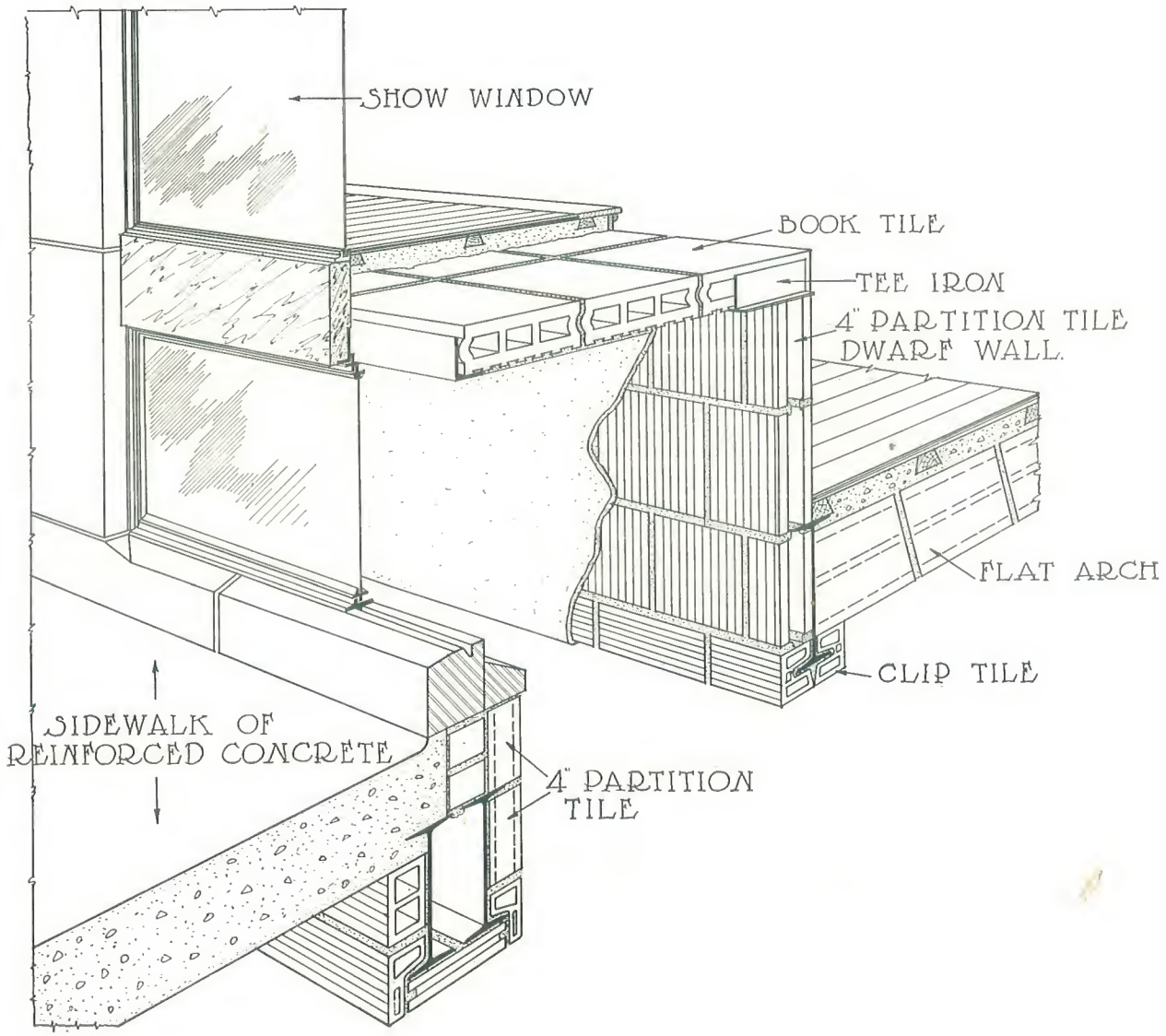


Fig. 1043
Typical Bulkhead Construction showing 4-inch Partition Tile in Dwarf Wall and Book Tile forming Show Window Floor.

BOOK TILE

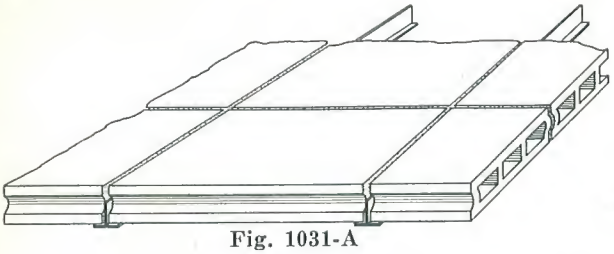


Fig. 1031-A

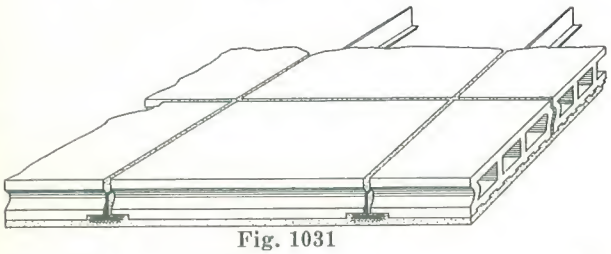


Fig. 1031

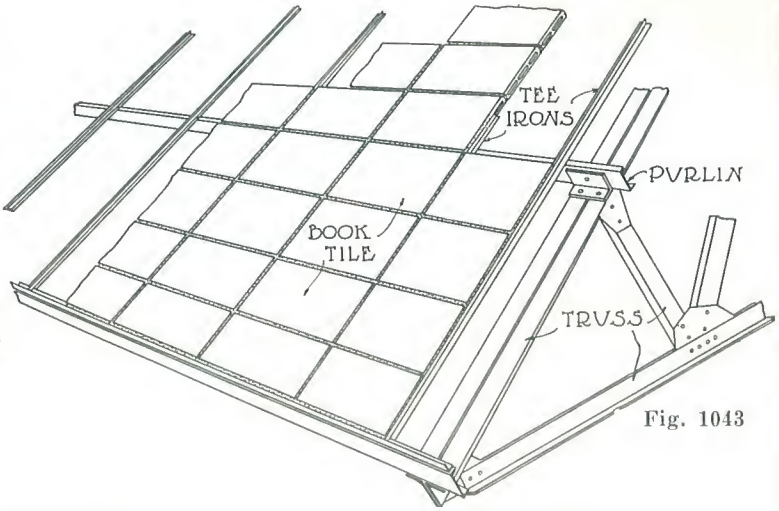


Fig. 1043

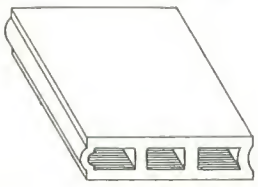


Fig. 1043-A

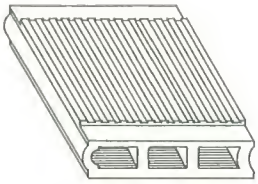


Fig. 1043-B

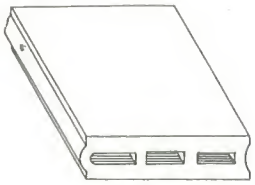


Fig. 1043-C

These tile are called "Book Tile" on account of their shape, and they are made especially for roofs to be covered with concrete, tar and felt or any composition roofing. They are made of uniformly hard-burned material either 3 or 4 inches thick (3 inches is the standard thickness), and of a length depending upon the weight to be carried. If finished roofing must be nailed, the book tile can be made porous with heavy shells at an increased cost.

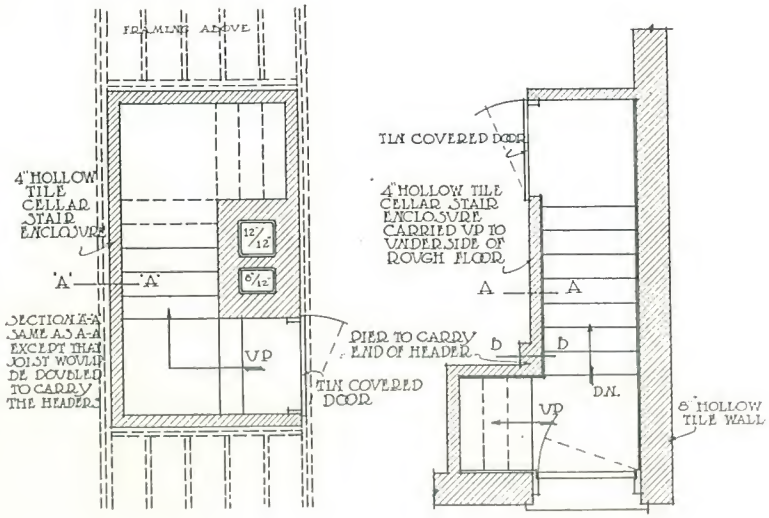
Specifications for the steel frame work should call for the spacing of T's to be 1-inch wider than the length of the tile; for example, for tile 18 inches long the T-irons should be spaced 19 inches on centers.

When the tile are not to be plastered on the inside or the T's protected, the tile may be cut square at their ends and be laid upon the flanges of the T's, but where the tile are to be plastered when specially ordered, they can be rabbeted so that the bottom of the tile will drop a little lower than the flange (as shown by Fig. 1043-B). If the flange of the T is narrow the plaster will cover without trouble, but where the flange is of considerable width it should be wrapped with galvanized diamond mesh expanded metal lath before the tile are set.

Book tile are used for covering the flat roofs of pent houses, bulkheads, etc., and may be used for the main flat roof of a building when only light live loads are anticipated, and a light roof must be carried on trusses. If heavy live loads are expected, use Flat Arches on I-Beams or "Combination" Long Span Construction, as the cost of T framing that is saved will largely offset the extra cost of Arch over Book Tile. When providing for future increase in height of a building, a floor of flat arches is set and roof grading of book tile placed on temporary supports of T's (or dwarf-walls).

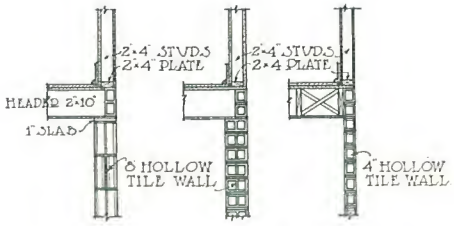
A hung ceiling of Book Tile has ample strength to support the weight of a man and piping, and forms an excellent working pipe space where it is necessary to get at the piping which is not possible with most other forms of plastered ceiling.

FIREPROOFING THE STAIR WELL



DETAIL SHOWING CELLAR STAIRS IN A CENTRAL POSITION.

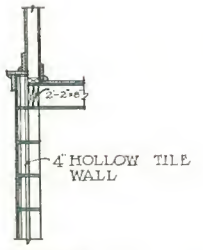
DETAIL SHOWING CELLAR STAIRS IN CORNER.



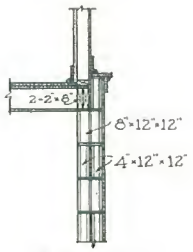
SECTION B-B ALTERNATE SECTION B-B

SECTION A-A

Fig. 1016
Construction of stair well walls with Hollow Tile offers a barrier to the spread of fire in the most important avenue of egress. Where these stair walls occur in connection with exterior walls they are bonded into and become a part of these fireproof exterior walls



SECTION B-B



SECTION C-C

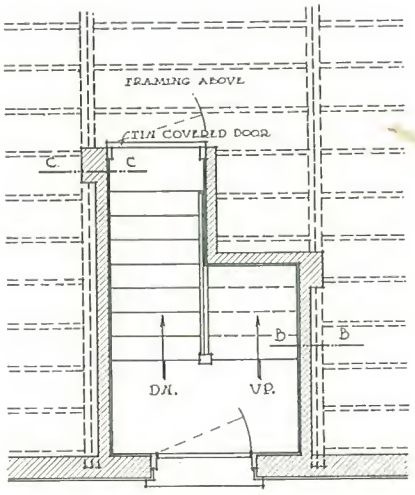


Fig. 1015
Method of building fireproof stair well walls with Hollow Building Tile. These walls are tied in and bonded with the exterior walls

SPECIFICATIONS RECOMMENDED FOR HOLLOW TILE FIREPROOFING

(1) In General:

The contractor for the fireproofing shall furnish all the Hollow Tile material required for the floor and roof construction, including the fireproofing of all structural steel work, beams, girders, lintels, columns, etc., excepting where steel is indicated as being encased in the wall or other masonry, or specifically referred to as being left exposed (such as roof trusses, elevator sheave beams, etc.), also the Hollow Tile for partitions, furring and such other work as indicated on the drawings.

This contractor shall furnish all labor, transportation, tools and equipment and all other materials required to erect the Hollow Tile fireproofing and other construction in accordance with the drawings and as hereinafter specified, all conforming to the best and latest practice and to the satisfaction of the architect; only skilled tile setters to be employed for the setting.

Contractors shall carefully examine the steel framing, drawings and structural details and provide for the complete and proper fireproofing of the structural frame.

(2) Material:

All Hollow Tile fireproofing shall be of hard burned (dense) or (semi-porous) ware that will develop a crushing strength of at least 1525 pounds per square inch of net sectional area of the tile when tested on end. No badly split, cracked, warped or underburnt tile shall be used.

Book tile roofing, solid beam and girder covering (nailing tile) and such other items as are specifically so noted shall be hard burned, full-porous ware.

All Hollow Tile fireproofing shall be capable of withstanding the tests prescribed by the "National Board of Fire Underwriters" standards for fire resistive floor, wall and partition construction.

(3) Size and Dimensions of Tile:

All Hollow Tile arching shall be of the shape required to carry and transmit the loads with an ample factor of safety.

Floor arch tile shall have the outside shells not less than $\frac{3}{4}$" in thickness and the webs not less than $\frac{5}{8}$" in thickness, excepting that the shells and webs of keys and skewbacks, or other shapes that must resist both compression and shearing stress, shall be thicker when required. Skewbacks shall

be designed to resist the combined shear and thrust from arch and be formed to fit and protect the various steel sections on which they are set.

Partition tile shall have shells not less than 5/8" and webs equal in thickness, number, and arrangement to Hollow Building Tile Association Standards.

Cross webs in all arch and fireproofing shall be spaced not over 4" on centers and all blocks 8" or more in thickness shall have at least one mid-web.

The faces of all tile that are to receive plastering or mortar shall have the standard scoring. The thickness of the shells of side construction arches shall be made sufficient to resist the combined compression and shearing stresses, with ample fillets at all intersections of webs and shells.

Beam, girder and lintel fireproofing shapes when hollow shall have shells at least 5/8" in thickness, or if solid, be of porous or semi-porous ware and at least 1½" thick at extreme edge of metal.

(4) Fireproofing Steel:

The thickness of fireproofing around steel members shall in no case be less than the following (and thicker where necessary to conform to existing State or Municipal ordinances or by-laws):

Soffit coverings on lower flange of beams supporting flat arches shall be 1½" thick if of solid material and 2" thick if made hollow.

Covering on beams and girders extending below the soffit of arches: at least 2" thick for plain rolled sections and 3" thick on flanges for all heavy built up sections, plate girders, trusses, etc. Web covering shall be built out solidly to the thickness required in all cases.

Solid Tile column fireproofing for round or other special columns shall be at least 2½" in thickness of porous or semi-porous ware.

(5) Detail Drawings:

This contractor shall submit to the architects for approval any required detail drawings, showing the form, section and method of applying the fireproofing to the steel work, etc., before starting the manufacture of material. Details to be full size where any special shapes are required.

Stock shapes may be used throughout for the fireproofing of beams and girders, columns, etc., where they conform to the requirements of this specification and fit the contour of the steel

For columns carrying heavy truss members (or very heavy loads) and in special cases where so indicated two thickness of 2" thick Hollow Tile covering should be specified, set with broken joint in each course and between courses.

sections. Elsewhere the contractor shall furnish, without extra cost, all other shapes required to properly fit and encase the steel work.

(6) Scaffolding and Centers:

Contractor shall provide his own hoisting rig and all scaffolding, centers and forms required for the setting of his work. Scaffolding and centers to be provided in sufficient quantity to insure the rate of progress outlined in contract.

This contractor shall also furnish the proper protection for his men and for those working under him, as required by the City and State laws.

(7) Mortar and Laying:

All arches, fireproofing, partitions, furring, etc., shall be set in cement mortar composed by volume of one part (approved brand) Portland cement to three parts clean sharp sand. Not over 15% of the cement by volume of hydrated lime may be added.

Cements, sand, etc., shall conform to the requirements elsewhere specified under the heading of "Masonry."

All tile shall be laid with full buttered end and side joints and shall be shoved to a bearing on a full bed of mortar with as close a joint as possible, pointing up and filling all crevices with mortar.

In warm weather all tile shall be thoroughly wetted before setting. Frost shall be driven from the tile by heating when setting is carried on during cold weather and no fireproofing shall be set when the temperature is below 20 degrees Fahrenheit without the permission of the architect.

(8) Flat Arches:

All floors throughout (including the main roof and the roof in light court), except where otherwise noted, shall be constructed of ...." deep end construction flat arches having (side construction) skewbacks and keys of the sizes required to fit the several spans without cutting.

Alternate Mortar Mixture: In a mortar composed of one part Portland cement, three parts sand, combined with lime mortar in proportions of three parts cement mortar to one part lime mortar, all thoroughly mixed; the lime mortar to be well seasoned and composed of one part thoroughly slaked, freshly burned lime and four parts sand. Mortar having taken its initial set shall not be used, retempering will not be permitted.

Omit the words "side construction" inserted above if an all end construction arch is desired.

If it is desired to use side construction throughout in lieu of arch with end construction fillers, the following alternate specifications should be used, noting, however, that for a given depth shorter spans must be used; therefore the side construction arch is heavier and the steel design less economical than for the combination or all end construction arches which are equal in carrying capacity.

Flat Arches: All floors, etc., shall be constructed of ...." deep side construction flat arches with keys of the required sizes to fit the several spans and shall be set with broken joints in each course, working up to and between the tie rods, by using the required short lengths for starters and closures.

Any additional keying or wedging required shall be done with tile slabs or slate.

Solid beam soffit tile shall be separate from the skewbacks and of the proper size, having bevelled sides so as to be securely keyed in place by the skewbacks.

Skewbacks shall be of the size required and be properly formed or coped to fit the various beam sections.

Whenever possible, any openings required in arches for pipes, etc., shall be formed or left at the time of setting so as to avoid later cutting.

(9) Segmental Arches:

All.....shall be 6″ (or 8″) deep, side construction segmental arches, set on skewbacks of the forms indicated on drawings, properly encasing the lower flange of beams, all segment lengtheners to be uniform size, except where smaller sizes are required for keying up, and shall be set with broken joints in each course, carefully fitting up to and between tie rods by using the required short lengths for starters and closures.

Solid beam soffit tile shall be separate from the skewback and of the proper size, having bevelled sides so as to be securely keyed in place by the skewbacks.

Where there is no fireproof ceiling below the arches specify (all portions of tie rods below the soffit of arches shall be encased with tile).

It is customary to specify the concrete haunch filling on segmental arches separately from the sleeper fill, making the latter a separate operation. Therefore, the haunch fill of 1-2-5 stone concrete up to the top of beam flanges should be specified here, using haunch fillers of Hollow Tile wherever practical to reduce dead load. (The cinder fill between sleepers may be elsewhere specified with the floor work.)

(10) Beam and Girder Covering:

All beams, girders, or other steel members, extending below the soffit of arches, shall be encased in Hollow Tile of the thickness specified, all to be properly fitted and set with well filled mortar joints encasing the entire length of beam and where necessary be securely strapped or clipped in place with 1″ by No. 16 gauge band iron or No. 10 gauge galvanized iron wire. Where metal fastening is necessary, as in the case of wide soffits,, the soffit tile shall be hollow and the metal clamp be arranged in the hollow space; these soffit tile to be also keyed into place by mortar joints. The fireproofing of main carrying beams and girders shall be independent of the floor arch construction and shall extend up to top flange so that openings for pipes, etc., that may be left or cut will not expose the webs or flanges of any members of the structural frame. All spandrel beams and girders and other lintel members shall be protected with tile fireproofing where not indicated as being encased in the masonry of walls.

(11) Book Tile Roofing:

The roofs of penthouses and vent shafts, also the backs and ends of saw-tooth skylights and mansard roof and top of cornice and the pitched roofs of tower or dome, shall be constructed of 3″ book tile, set on "T" irons which will be provided and erected by the steel contractor.

The floor of bulkheads in show windows shall also be constructed of book tile.

"T" irons should be set 19 inches, 21 inches or 25 inches c-c for Standard Book Tile.

(12) Suspended Ceilings:

The ceiling under roof in (top) story and the ceiling of boiler room (also the soffits of stairs, where so indicated) shall be constructed of 3″ book tile ceiling blocks, set on "T" iron framing provided and erected by the steel contractor.

Book tile for ceilings shall be coped so as to give a level ceiling and before setting the lower flange of "T" irons shall be wrapped with a strip of galvanized light weight diamond mesh expanded metal, or galvanized woven wire mesh.

(13) Column Covering:

All interior columns (and such other columns that are so indicated on the drawings) shall be encased with Hollow Tile as indicated, set 1″ free of the steel, all channel spaces in columns shall first be filled in solid with Hollow Tile or a fine stone or gravel concrete, or broken tile and cement mortar.

As the wall columns are generally encased in the brick or Hollow Tile masonry of exterior walls, it is customary to cover such columns under the wall masonry specifications.

The steel column shall be plastered with a full ½″ coat of Portland cement mortar just in advance of the setting of the tile covering.

Column covering shall in all cases start on the top of the fireproof floor construction and be carried up to the underside of fireproof ceiling above, each course of tile to be set breaking joint with the one below and be wrapped once in every course with 10-lb. galvanized iron wire, or be tied together with "U" shaped clips of band iron in each course.

Where so indicated, column covering shall have rounded corners.

No piping shall be enclosed in the column fireproofing, excepting electric conduits, not over ⅝″ in size, built into the channel space before the column covering is set. These conduits shall be grouted in solid with at least 3″ of solid material between conduit and the face of steel. All other piping at columns shall be separately inclosed in ducts as indicated and hereinafter specified.

(14) Wall Furring:

The furring of exterior walls (and the party walls where so shown, including the walls of basement), where free standing shall be built of 3″ (or 4″) hollow partition tile, the same as partitions, elsewhere the furring of all exterior and party walls shall consist of 2″ split furring tile built against and secured to the brick or other masonry with approved metal wall ties previously built into the masonry, or with galvanized heavy 4″ wire nails driven into the joints of same every second course in height and not over 3′ 0″ apart.

Wall furring, where so indicated, shall be returned into jambs at windows (including the furring down at window soffit).

(15) Special Furring, Pipe Enclosure, Etc.:

Where indicated on drawings, the walls, columns, piers, etc., shall be furred out to the lines required by the architectural details for the special form and finish of the room, corridors, etc., as indicated, forming all offsets, reveals, pilasters, etc., using partition tile of the required size. In general this work shall be done with 3″ partition tile with brace or cross walls of same size blocks wherever required. Cross walls shall be anchored or tied into both furring and masonry.

All piping, conduits, etc., where so indicated shall be inclosed with 2″ or 3″ partition tile; chases in walls to be similarly covered. This work shall be independent of the column fireproofing and be arranged so that the piping is left accessible until after it has been tested.

(16) Partitions:

All partitions and interior division walls shall be built of light weight Hollow Partition Tile of the several thicknesses indicated on drawings. Sizes not marked on plans shall be as follows:

Partitions enclosing elevator and stair walls, pipe shaft, etc., and all partitions over 18′ 0″ in height to be 6″ thick.

Division walls in stores on ground story to be 8″.

All main and corridor partitions and all partitions around toilet rooms, etc., also all sub-dividing partitions over 14′ 0″ in height to be 4″ thick.

All other partitions to be 3″ thick.

All division walls, main and corridor partitions shall start directly on the arches; but sub-dividing partitions may be built on the floor filling and where so indicated shall be built on the top of finished floor to provide for tenant changes.

For the attaching of furring to concrete walls No. 13 gauge galvanized iron wire loops shall be built into the concrete.

All partitions to be carried up to and be wedged tightly against the underside of fireproof ceiling or beams above.

Where there are more than two courses of partition tile the heads of doors or other openings in sub-dividing partitions and over all openings wider than 3′ 6″ jack arches, light steel lintels or suitable reinforcement of band iron shall be provided and similar lintels shall be provided over all openings in main partition wall furring, etc.

All partitions shall be built true to a line and plumb and at all intersections shall be bonded together or be tied with approved metal ties or with band iron. Provision shall be made for securely anchoring all heavy door frames and for all metal door frames which are not fastened to the steel framing.

All partitions, furring, column casing or other items built with partition or furring tile shall be well bonded by breaking joints at least 3″ in each course, all joints to be thoroughly bedded and flushed and pointed up with mortar.

Double partitions shall be bonded together and stiffened with cross walls of the same material, as shown on drawings. All anchors, ties, etc., required for this work to be furnished by this contractor.

(17) Vaults:

The lining of fireproof vaults shall consist of a 4″ Hollow Partition Tile built 2″ free of and anchored to the vault wall masonry by hollow header brick. The wall of storage vaults on .... stories shall consist of a double 4″ partition tile (or a double 4″ and 6″ partition) breaking joints in each course. Vault doors to be securely anchored at least two courses deep in every second course.

(18) Pent Houses and Other Walls:

The walls of pent houses and vent shafts on roof (also the wall of pipe tunnel back of cornice) shall be built of 8″ exterior wall tile having a deep scoring to receive the cement stucco. All openings in tile at the top of these walls shall be capped with a tile (slab) before the cresting or coping is set.

(19) Bulkheads and Skylight Curbs:

The bulkheads and skylight curbs where indicated as covered with sheet metal shall be built of 3″ (or 4″) thick Hollow Partition Tile. Elsewhere they shall be built of 6″ (or 8″) exterior wall tile same as pent houses. The roof of bulkheads (unless otherwise shown) shall be constructed of 3″

book tile, set on loose "T" irons which will be furnished by another contractor but be set by this contractor.

(20) Miscellaneous Iron:

All loose light steel sections and miscellaneous ironwork occurring in connection with the Hollow Tile fireproofing work, excepting anchors, ties (reinforcement), band iron, etc., will be furnished by other contractors, but shall be set by this contractor without extra charge.

(21) Raised Floor:

The raised floors in toilet room where indicated shall be constructed of 3x12x18 book tile or heavy section partition tile set on dwarf walls of partition tile and brick. This work shall be so arranged as not to interfere with the installation of the plumbing work. These floors to be closed up only after the pipes have been tested and approved.

No cinder concrete shall be allowed to come in contact with the structural steel that is exposed above the arches, all exposed steel shall first be covered with at least three-fourths inch of cement mortar (or with Hollow Channel Tile set in cement mortar). All piping, etc., occurring in the floor filling, except electric conduits, shall also be protected with cement mortar (or be covered with Hollow Channel Tile).

The filling under marble, cement, tile, terrazzo and other floors may also be specified under this heading, but it is generally preferable to have this work done by the contractor laying such floor, so that the base and floor finish may be laid at the same operation and a proper bond secured.

When the floor filling is to be included in the fireproofing contract specify as follows:

Sleeper Filling: The carpentry contractor will furnish and set the beveled wood floor strips, after which this contractor shall fill to within one-fourth inch of the top of same with cinder concrete, composed of one part Portland cement, two parts sand and eight parts good clean cinders, free from large clinkers, fine ash or flue dust.

(22) Roof Fill and Finish:

Specify here the required fill and finish where Hollow Tile arches occur, unless roof grading is of wood construction.

(23) Load Tests:

All Hollow Tile arches shall be capable of sustaining a load of three times the required live load, per square foot, and they shall be tested by the contractor where so directed by the architects.

(24) Cutting and Patching:

This contractor alone shall do all cutting and patching of the arching, beam, girder and column fireproofing that may be required for the roughing in of piping, etc., or the installation of other work, the cost of which (actual labor cost plus 10%) shall be reported to the general contractor (or architect), who will adjust same with the contractors for whom this work is done.

The cutting and patching of partitions and furring, etc., will be paid for by the contractors whose work occasions same.

All other cutting and patching and the repairing of all Hollow Tile work so as to leave the whole work perfect and complete shall be done by this contractor at his own expense.

(25) Removal of Rubbish:

Upon completion of the Hollow Tile fireproofing and whatever else required by the architect's superintendent, this contractor shall clean up and remove from the premises any refuse and surplus material resulting from this work, leaving the premises clear of such rubbish. This contractor, however, may use the broken tile in the floor filling, provided same is broken into **small pieces and kept free from plaster, wood chips and other rubbish.**

Where the backing of face brickwork consists of Hollow Tile blocks, the clause "Wall Furring" should be omitted and the portions of the specification for Hollow Tile wall construction, page 58, which apply to this work, should be inserted in the "Masonry" specifications.

On all large or complicated Hollow Tile construction work we recommend that a complete set of plans and specifications be sent to the tile manufacturers for their estimate on furnishing the required amount of Hollow Tile necessary to complete the operation.

All manufacturers will gladly co-operate with architects, engineers and builders in solving any special problem in connection with Hollow Tile construction.

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